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John Hunter, MS. Lectures, 1787.

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1879

PREFACE TO THIRD EDITION.

In presenting to my professional brethren the Third Edition of a book which has been so kindly received as this, I have only to express a hope that it will not prove less acceptable than its predecessors. The whole has been carefully revised, much of it has been re-written, important additions have been made to almost every chapter, and, of the six hundred and seventy-two wood-cuts, eighty-eight are new.

THOMAS BRYANT.

53, Upper Brook Street,
Grosvenor Square;
London, *December*, 1878.

PREFACE TO SECOND EDITION.

A SECOND EDITION of this manual having been called for, I have availed myself of the opportunity to make some alterations in the substance as well as in the arrangement of the work, and, with a view to its improvement, have recast the materials and revised the whole. I have, also, to make the work more complete, added much new matter, including chapters on diseases and injuries of the eye and ear, some remarks on dental surgery, on the diagnosis of ovarian tumors, and on deformities, together with at least one hundred new wood-cuts.

The book has also, for the sake of greater convenience, been divided into two volumes,[1] the first including the elementary principles of our art, general subjects, tumors, the surgery of the cutaneous, lymphatic, nervous, circulatory, and digestive systems; and the second the surgery of the respiratory, urino-genital, muscular, and osseous systems, gunshot wounds and amputations, with a full general index.

I am well aware that I have failed to realize, in the execution of my task, the ideal standard I, at starting, proposed to myself, and I knew when I first undertook to write the book how difficult it was to compress the treatment of the vast range of subjects included under the title of Surgery into one volume; but my object was to offer such an epitome of the main principles and methods of practice as should be serviceable to the student and practitioner; and from the reception the first edition of this work, published in November, 1872, has met with in Great Britain and America, I feel justified in saying that I have not failed in the attempt, and that the book supplied a want felt by the professional public.

To the many reviewers, who have acknowledged my labors so fairly and so fully, my thanks are clearly due, but still more to the profession which has welcomed my humble services so kindly.

Fully alive, therefore, to the generous appreciation of my past work, and assuring my readers that no pains have been spared to bring the present up to as high a standard as my time and opportunities have allowed, I submit it in all confidence to the kind consideration of my professional brethren as no unworthy exposition of modern British Surgery.

---

[1] Comprised in one volume in the American Edition.

In its execution I have endeavored to acknowledge on all occasions the claims of others, and whatever merit or novelty may attach to their views or operations; for my wish has been to represent not so much my own opinion as the position of Surgery at the time I write.

It only remains for me to express once more my obligations to Mr. Thomas Turner, the Treasurer of Guy's Hospital, by whose kindness the materials in the unrivalled collections of that institution were placed at my disposal; to my colleagues, Drs. Moxon, Goodhart, and Purves, Messrs. Howse, C. Higgens, and Moon; and to Mr. Wesley, the artist who has so ably illustrated these pages.

Since I first undertook this work death has deprived me of two colleagues, Mr. Poland and Dr. Phillips, both of whom rendered me many friendly services and much valuable assistance. I refer to their names with gratitude and regret.

53, UPPER BROOK STREET,
GROSVENOR SQUARE;
March, 1876.

CONTENTS

WITH

LIST OF ILLUSTRATIONS.

INTRODUCTORY CHAPTER.

PAGE
How to Investigate a Case—Diathesis—Cachexia, etc. 17

CHAPTER I.

On Repair—Inflammation—Abscess—Sinus—Ulcers—Bedsores—Mortification—Hospital Gangrene—Erysipelas—Traumatic Fever—Septicæmia and Hectic 23

FIG. PAGE
1. Diagram illustrating the process of repair 24
2. Pus-corpuscles 29
3. Abscess knife 31

FIG.
4, 5. Thermographs of erysipelas . 48
6. Thermograph of pyæmia . . 55
7, 8. Thermographs of traumatic fever 55
9, 10. Ditto ditto 55

CHAPTER II.

Animal Poisons—Poisoned Wounds—Insect Bites—Serpent Bites—Hydrophobia—Glanders and Syphilis—Vaccino-Syphilis 63

11. Anatomical tubercle 64
12. Syphilitic deposit in testicle . . 74
13. Hereditary syphilis . . . 78

14. Syphilitic teeth 79
15. Healthy teeth 79

CHAPTER III.

Tumors, with their Microscopical Anatomy 82

16. Serous cyst of neck 87
17. Sebaceous tumors in scalp and horn 90
18. Fungating follicular tumor . . 90
19. Fatty tumor 91
20. Fibrous tumor 93
21. Enchondromatous tumor . . 94
22. Adenoid tumor 95
23. Cancer of bone 100
24. Melanotic cancer 101
25. Cancer of stump 102

26. Rodent cancer 102
27. Colloid tumor of breast, with section 103
28. Microscopical anatomy of osteoma, enchondroma 110
29. Ditto, sarcoma 111
30. Ditto, myxoma 112
31. Ditto, adenoma 113
32. Ditto, carcinoma 114
33. Ditto, lymphoma 115

SURGERY OF THE CUTANEOUS SYSTEM.

CHAPTER IV.

Contusions—Wounds—Sutures—Burns and Scalds—Cicatrices—Skin-Grafting—Chilblains—Frostbite—Boils and Carbuncles—Malignant Pustule—Perforating Ulcer of Foot—Oriental Sore—Fungus Disease of India—Warts—Moles—Corns—Bunions—Affections of Nails—Elephantiasis Arabum—Parasites . 116

34. Interrupted suture 119
35. Continued suture 119

36. Twisted suture 119
37, 38. Quilled suture 120

CHAPTER IV—*Continued.*

FIG. PAGE
39. Rib pierced by arrow . . . 122
40. Axillary cicatrix after burn . . 127
41. Mode of applying extension after its division 127
42. Effects of burn on neck 127
43. Cheloid of Alibert 129
44. Cheloid of Addison . . . 129
45. Scissors for skin-grafting . . 130
46, 47. Drawings illustrating the cicatrization of sores by skin-grafting . 131
48, 49. Drawings illustrating growth of black skin when grafted on sore of white man 132
FIG. PAGE
50. Bunion 140
51. Toecap for cure of bunion . . 140
52. Ingrown toe-nail 141
53. Acute onychia 142
54. Chronic onychia 142
55. Horny growth beneath nail . . 143
56. Ungual exostosis 143
57. Elephantiasis Arabum before operation 144
58. Ditto, after 144
59. Guinea-worm bleb 145

SURGERY OF THE LYMPHATIC SYSTEM.

CHAPTER V.

Inflammation of Lymphatics—Hodgkinson's Disease of Glands—Diseases of Thyroid Gland 146

60. Exophthalmic goitre . . . 150
61. Pedunculated thyroidal tumor . 152
62. Microscopical appearance of thyroid glands 152

SURGERY OF THE NERVOUS SYSTEM.

CHAPTER VI.

Injuries of the Head—Contusions and Wounds of Scalp—Ostitis—Fractures—Concussion—Compression—Wounds of Brain—Hernia Cerebri—Inflammation of Brain—Trephining—Disease of Scalp and Cranium—Tetanus—Delirium Tremens—Shock and Collapse—Feigned and Hysterical Disease . . . 154

63. Gutter-shaped fracture of skull . 157
64. Saucer-shaped ditto . . . 157
65. Comminuted fracture of skull with depression of inner table . . 157
66. Fracture of base of skull . . 158
67. Fracture of anterior fossa of the base of the skull 161
68. Punctured wound of skull . . 161
69. Extravasation of blood between bone and dura mater 166
70. Hernia cerebri 171
71. Operation of trephining with instruments 177
72. Meningocele at root of nose . . 181
73. Encephalocele 182
74. Necrosis of frontal bone . . . 182

CHAPTER VII.

Injuries and Diseases of the Spine—Spina Bifida—Congenital Sacral Tumors—Concussion—Intra-spinal Inflammation—Spinal Paralysis—Fractures and Dislocations—Wounds and Sprains—Curvature of Spine—Injuries and Diseases of Nerves—Neuralgia—Neuroma 193

75. Dissection of spina bifida . . 193
76. Double spina bifida . . . 194
77. Cured spina bifida 194
78, 79. Congenital coccygeal tumors . 196
80. Dislocation of spine . . . 201
81. Fracture of spine 202
82, 83. Lateral curvature of spine . 207
84, 85. Angular curvature of spine . 208
86, 86A, 86B. Disease of cervical vertebræ 209
87. Synostosis of ribs to vertebræ . 210
88, 88A. Sayre's apparatus for spinal curvature 211

CHAPTER VIII.

Diseases and Injuries of the Eyelids and Eye, with Operations on Eyeball and its Appendages—Affections of the Orbit 216

89. Liebreich's ophthalmoscope . . 218
90. Indirect ophthalmoscopic examination 220
91. Accommodation and refraction . . 223
92. Oldham's ophthalmoscope . . 225

CHAPTER VIII—*Continued.*

FIG. PAGE
93. Position of patient for minor operations 250
94. Position for major operations . . 250
95. Compressorium forceps . . . 253
96. Compressorium forceps, applied . 253
97. Wire speculum 255
98. Grooved director for slitting canaliculus 257
99. Instruments for operations for strabismus 260
FIG. PAGE
100. Instruments for iridectomy . . 264
101. Wecker's scissors 266
102. Artificial pupils 267
103. Instruments for extraction of cataract 269
104. Incisions for extraction of cataract . 270
105. Instruments for removal of cataract with scoop 272
106. Extirpation scissors 274

CHAPTER IX.

Affections of the Ear, External, Middle, and Internal 282

107. Occlusion of external auditory canal, with deformed auricle, and lobulus displaced on cheek 282
108. Politzer's method of examining middle ear 283
109. Effects of injury on ear . . . 283
110. Cheloid tumor of ear 284
111. Microscopical appearances of same . 284
112. Hæmatoma auris 284
113. Syringing ear 287
114. Appearance of membrana tympana 291

SURGERY OF THE CIRCULATORY SYSTEM.

CHAPTER X.

Wounds of the Heart and Arteries—Hemorrhage and its Treatment—Diseases of Arteries—Embolism—Aneurism and its Treatment—Nævus—The Ligature of Arteries—Special Aneurisms 297

115. Effects of natural hæmostatics . 300
116, 117. Effects of contusion on an artery 300
118. Effects of ligature on an artery . 301
119. Effects of torsion on an artery . 302
120. Drawing showing application of ligature to artery, tourniquet, torsion forceps, etc. 304
121. Different modes of acupressure . 306
122. The femoral artery twisted . . 306
123. Artery constrictor (Mr. Spier's) . 307
124. Roussel's injecting apparatus . . 310
125. Inflammatory change in artery that precedes atheroma 312
125A. Atheroma of artery 312
126. Section of artery plugged by an embolus 315
127. Sacculated traumatic aneurism . 316
128. Multiple aneurisms 316
129. Laminated clot from aneurism . 318
130. Section through cured aneurism . 319
131. Mode of applying pressure to femoral artery for the cure of aneurism 322
132. Weiss's double pad for pressure . 323
133. Mr. G. Cole's pad for elastic pressure 324
134. Dix's mode of compressing artery . 326
135. Diagrams showing the different operations for aneurism 327
136, 137. Drawings illustrating the collateral circulation in the lower extremity after the application of a ligature to the external iliac artery 332
138. Different forms of arterio-venous aneurism 333
139. Mr. Cock's case of arterio-venous aneurism 333
140. Cirsoid aneurism of foot . . 334
141. Degenerating nævus 336
142. Mode of ligaturing nævus . . 336
143. Effects of nævus of upper lip . . 337
144, 144A. Modes of ligaturing large nævi 337
145. Needle for the application of a subcutaneous ligature to a nævus . 338
146. Diagram illustrating the application of a ligature to an artery . . 340
147. Best form of aneurism needle . . 340
148. Incision for the application of a ligature to aorta or common iliac artery 341
149. Operation for ligaturing common carotid and facial arteries . . 343
150. Operation for ligaturing the subclavian and lingual arteries . . 346
151. Ligature of axillary artery . . 347
152, 153. Ligature of brachial artery . 348
154. Ligature of radial (upper third) artery 349
155. Ligature of radial and ulnar arteries 349
156. Ligature of external iliac and femoral arteries 351
157. Ligature of posterior tibial artery . 354
158. Ditto, behind malleolus . . . 354
159. Ligature of anterior tibial artery . 355
160. Ligature of dorsalis pedis . . 355

CHAPTER XI.

Injuries and Diseases of the Veins—Operations on Veins 356

161. Drawing illustrating case in which the inferior vena cava was obstructed 360
162. Varicose veins 362
163, 164. Venesection 364, 365

SURGERY OF THE DIGESTIVE SYSTEM.

CHAPTER XII.

PAGE
Affections of Lips, Mouth, Tongue, Palate and Tonsil—Harelip—Cancer—Tumors—Ranula—Salivary Calculus—Parotid Tumor—Cancer of Tongue—Fissured Palate 366

FIG. PAGE
165. Drawing illustrating formation of upper jaw 366
166. Central fissure of lip 366
167, 168, 169. Drawings illustrating degrees of single harelip . . . 366
170, 171. Drawings illustrating double harelip 367
172. Position of patient for operation of harelip 367
173. Operation for single harelip . . 368
174. Hainsby's truss for harelip . . 368
175, 176. Collis's operation for harelip . 368
177. Malgaigne's operation . . . 368
178, 179. Operation for double harelip . 369
180, 181, 182. Ditto, with projecting intermaxillary bones . . . 369
183, 184, 185. Drawings illustrating cheiloplastic operations for deformed mouth 369
186. Cancer of lower lip . . . 370
187, 188. Drawings illustrating operation for formation of new lip . . 370
189. Hypertrophy of mucous glands of lip 371
190. Cancrum oris 372

FIG.
191. Ranula or sublingual cyst . . 373
192. Salivary calculus 373
193. Submaxillary tumor . . . 375
194. Tongue forceps 377
195. Figures illustrating operation for the removal of tongue . . . 378
196. Diagram illustrating different operations for removal of tongue . . 378
197. T. Smith's gag 379
198. Fergusson's knives for operations on palate 380
199. Figure illustrating the paring of the edges of fissured palate after introduction of sutures . . . 380
200. Needles employed in fissured palate 380
201, 202. Drawings illustrating operation for fissured palate . . . 381
203, 204. Drawings illustrating Fergusson's operation on hard palate . 382
205. Trendelenburg's tracheal tampon . 383
206, 207. Tonsil guillotine and mode of application . . . 384, 385
208. Removal of tonsil with knife . . 385

CHAPTER XIII.

Diseases of Gums, Jaws, Teeth, Pharynx, and Œsophagus—Fractures, Dislocations, Necrosis, Tumors, Dysphagia—Foreign Bodies—Œsophagctomy . . 386

209. Fibrous epulis from gum . . 386
210. Epulis springing from bone . . 386
211. Tooth odontome 386
212. Odontome after removal . . 386
213. Ditto, in section 386
214. Necrosis of lower jaw with condyloid process 388
215. Dentigerous cyst of upper jaw with tooth 390
216. Ditto, of lower jaw . . . 390
217. Dentigerous tumor of upper jaw . 391
218, 219. Enchondromatous tumor of upper jaw 391
220, 221. Drawings illustrating lines of incision for removal of upper jaw 392
222. Saw for operation on jaw . . 392
223. Lion forceps for ditto . . . 392
224. Periosteal sarcoma of lower jaw . 393
225. Fibro-cellular tumor of lower jaw . 393
226, 227. Fibro-cystic disease of lower jaw 393
228. Dislocation of lower jaw . . 396
229. Reduction of dislocation of lower jaw 396
230, 231. Bandage and splint for fracture of lower jaw 398
232. Thomas's mode of adjusting fracture of lower jaw . . . 398
233. Moon's interdental splint . . 398
234. Metal caps for ditto . . . 398

235. Hammond's wire splint for fracture of jaw 399
236. Hammond's wire splint applied to ditto 399
237. Vertical section of tooth . . 400
238. Diagram of developing lower molar tooth 400
239. Radicular odontome . . . 403
240A. Malformed syphilitic teeth . . 404
240B. Healthy teeth 404
241. Drawing of child's jaws showing the development of the permanent teeth 406
242. Mouth mirror and searcher for the examination of teeth . . . 413
243. A series of drawings illustrating the progress of decay in teeth . . 415
244. Rhizodontropy 415
245. Drawing illustrating pivoting with vent 415
246. Manner of holding tooth forceps . 421
247. Stump forceps 421
248. Scoop elevators 421
249. Revolving pharyngeal forceps for removal of foreign bodies . . 425
250. Impacted pudding in œsophagus . 426
251. Horsehair probang for extraction of foreign bodies in œsophagus . 426
252. Money probang, with sponge . . 427

CHAPTER XIV.

PAGE
Injuries of the Abdomen and its Contents—Contusions—Rupture of Viscera—Wounds—Abnormal Anus—Foreign Bodies in Stomach—Gastrotomy and Gastrostomy—Intestinal Obstruction—Intussusception—Laparotomy—Enterotomy—Colotomy—Tapping Abdomen—Hydatids 428

FIG. PAGE
253. Diagram showing position of abdominal viscera 436
254. Mode of applying sutures to wound of intestines 437
255. Piece of iron wire discharged through abdominal walls after having been swallowed 439
256. Intestine strangulated by a band . 444
257. Ileo-colic intussusception . . 448
258. Operation of enterotomy . . 451
258A. Mode of fastening bowel to integument in 451
259. Thermograph of case of enterotomy 451
260. Colotomy 453

CHAPTER XV.

Abdominal Hernia—Its Anatomy—Irreducible--Obstructed—Inflamed—Strangulated—The Taxis—Herniotomy—Multiple and Displaced Herniæ—Inguinal and Radical Cure—Femoral—Obturator—Umbilical—Trusses 458

261. Diagram of congenital scrotal hernia 458
262. Diagram of a congenital hernia of the cord 458
263. Diagram of a congenital scrotal hernia, with hour-glass contraction . 458
264. Diagram of an acquired congenital form of hernia 459
265. Diagram of an acquired hernial sac 459
266. Diagram of a displaced hernia, second variety 459
267. Third variety 459
268. Fourth variety 459
269. Reduction *en masse* 459
270. Oblique inguinal hernia 462
271. Direct inguinal hernia 462
272. Femoral hernia 462
273. Drawings illustrating effects of strangulation of the bowel 467
274. Stricture of bowel, result of strangulated hernia 469
275. Key's operation for hernia . . 473
276. Drawing illustrating the relative position of the abdominal rings from within 473
277. Hernia knives 473
278. Spica bandage 476
279, 279A. Drawings illustrating the second variety of displaced hernia . 478
280. Interstitial hernia with ruptured neck of hernial sac—third variety . 478
281. Drawing illustrating the intra-parietal or fourth variety of displaced hernia 479
282. Wood's operation for radical cure . 484
283. Obturator hernia; external view . 488
284. Ditto, internal view . . . 488
285. Congenital umbilical hernia . . 488

CHAPTER XVI.

Surgery of the Anus and Rectum—Malformations—Injuries—Ulcers—Abscess—Fistula—Hemorrhoids—Prolapsus Recti—Polypus—Ulceration of Rectum—Stricture—Excision of Rectum—Atony—Rectal Alimentation . . . 493

286. Rectum ending in cul-de-sac above anus 493
287. Enormously distended rectum in man after operation for imperforate rectum in infancy 495
288. Speculum for examination of rectum 499
289. Operation for anal fistula . . 502
290. Internal hemorrhoids . . . 503
291, 292. Forceps for hemorrhoids . 506
293. Clamp for hemorrhoids . . . 506
294. Prolapsus recti 508
295. Villous polypus of rectum . . 509
296. Microscopical drawing of ditto . 509
297. Cancerous stricture of rectum . 512

SURGERY OF THE RESPIRATORY SYSTEM.

CHAPTER XVII.

The Surgical Affections of the Nose—Wounds—Fracture—Lupus—Cancer—Foreign Bodies in Nostril—Polypus—Ozæna—Diseases of Frontal Sinus—Rhinoplastic Operations, &c. 517

298. Repair of incised wound of nose . 517
298*a*. Forceps and nose truss for treatment of deformed nose 518
299. Nasal douche 518
300. Bellocq's canula for plugging nostrils 519
301. Lupus of nose 520
302. One form of flap for formation of new nose 520

CHAPTER XVII—*Continued.*

FIG. PAGE
303. Tube for insufflation of tannin into nose 522
304. Removal of nasal polypi by noose . 522
305. Cancer of nose 523
306. Enostosis of frontal sinus . . 526
307. Enostosis after removal . . . 526
308. Diagram of flap for rhinoplastic operation 526
309. Appearance of face after formation of new nose, flap having been taken from left side of forehead . 527

CHAPTER XVIII.

Surgical Affections of the Larynx and Trachea—Fracture—Wounds—Foreign Bodies in—Scalds—Tracheotomy—Excision 528

310. Bone in larynx 531
311. Date stone impacted in right bronchus 531
312. Gross's trachea forceps . . . 533
313. Laryngoscopic examination . . 535
314. Operation of tracheotomy . . 538
315. Durham's canula and pilot . . 539
316. Bryant's canula 539

CHAPTER XIX.

Surgery of the Chest—Contusions—Fractured Ribs and Sternum—Wounds—Abscess—Tapping—Apnœa—Artificial Respiration 540

317. Mode of strapping chest in fractured ribs 542
318. Position of patient for ejection of fluids after drowning . . . 549
318A. Artificial respiration by direct method 549

SURGERY OF THE URINO-GENITAL SYSTEM.

CHAPTER XX.

Diseases of the Kidney—Stone—Nephrotomy—Nephritis—Perinephritis—Hæmaturia—Suppression of Urine 550

319. Disease of the kidney, bladder, &c. 551
319A. Clover's bladder syringe . . 554

CHAPTER XXI.

Diseases of the Bladder and Prostate—Irritable Bladder—Inflammation—Ulceration—Vesico-intestinal Fistula—Tumors—Atony—Incontinence of Urine—Inflammation of Prostate—Hypertrophy—Atrophy—Calculus—Cancer . . 556

320. Sacculated bladder 559
321. Syphon mode of washing out bladder 560
322. Polypoid outgrowths from bladder . 562
323. Villous growth in bladder . . 562
324. Enlargement of third lobe of prostate 567
325. Prostato-vesical calculus . . . 570

CHAPTER XXII.

Stone in the Bladder and its Treatment—Lithotomy—Lithotrity 570

326. Epithelium from urinary passages . 571
327. Spermatozoa and vaginal epithelium 571
328. Urinary casts 572
329. Urates 572
330. Uric acid 572
331. Oxalate of lime 572
332. 333. Phosphates 573
334. Tyrosine and leucine . . . 573
335. Cystine 573
336. Renal calculus 574
337. Uric acid calculus with oxalate of lime nucleus 575
338. Mulberry calculus and section . 576
339. Mixed calculus 576
340. Cystic oxide calculus . . . 576
341. Phosphatic calculus on piece of tobacco pipe 577
342. 343. Catheters 580
344. Operation of lithotrity . . . 585
345. Ditto 586
346. Lithotrite 589
347. Lithotomy staffs 591
348. Ditto knives 591
349. Ditto scoop 591
350. Blunt gorget 592
351. Lithotomy bracelets 592
352. Lateral lithotomy with curved staff . 593
353. Lateral lithotomy with straight staff (Key's operation) . . . 594
354. Calculus removed from female bladder per vaginam 601
355. Portion of catheter removed from male bladder 602
356. Stiletto removed from female bladder 602

CHAPTER XXIII.

PAGE
Surgery of the Urethra—Obstruction—Stricture—Perineal Section—Urinary Fistula—Ruptured Urethra—Retention of Urine—Tapping Bladder—Extravasation of Urine 603

FIG. PAGE
357. Stricture of urethra 604
358. Olivary elastic catheter 605
359. Mode of fastening catheter in bladder 607
360. Richardson's urethral dilator . . . 609
361. Urethrotome with guide bougie . 610
362. Syme's perineal catheter . . 610
363. Grooved staff for Wheelhouse's operation 611
364. Teale's probe gorget 611
365. Wheelhouse's operation 612
366. Cock's operation of tapping urethra in perineum 613
367. Urinary fistula 616
368. Operation of puncturing bladder per rectum 625

CHAPTER XXIV.

Affections of the Male Genital Organs—Phimosis—Paraphimosis—Circumcision—Cancer—Injuries to Penis—Malformations—Local Venereal Disease—Gonorrhœa—Chancre—Hydrocele—Hæmatocele—Diseases of Testicle and Scrotum—Impotence—Spermatorrhœa 627

369. Operation for phimosis 627
370. Circumcision (first step) . . 628
371. Operation for paraphimosis . . 628
372. Stump after amputation of the penis by Hilton's method 629
373. Corpus spongiosum projecting from urethra after injury 630
374. Ectopion vesicæ in male . . . 631
375. Ditto in female 631
376. Perineo-scrotal hypospadias . . 632
376, B, C, D, E. Operation for perineo-scrotal hypospadias 632
377. Encysted hydrocele of cord . . 644
378. Tapping hydrocele 645
379. Mode of suspending testes with handkerchief 652
380. Hernia of testis following tubercular disease 658
381. Cystic disease of testicle . . . 660
382. Cancer of testicle 662
383. Strapping testicle 666
384. Testicle in perineum 667
385. Varicocele 667
386. Morgan's suspender for varicocele . 668
387. Elephantiasis of scrotum . . 669

CHAPTER XXV.

Surgical Affections of the Female Genitals—Wounds—Vulvitis—Labial Cysts—Imperforate Hymen—Rupture of the Perineum—Vesico-vaginal Fistula . 672

388. Central rupture of the perineum . 675
389. Operation for ruptured perineum . 675
390. Position of patient for operation for vesico-vaginal fistula . . . 677
391. Self-retaining speculum for ditto . 677
392, 392A. Mode of paring edges of vaginal fistula 677
393. Introduction of sutures in vaginal fistula 678
394. Speculum dilator for female urethra 679

CHAPTER XXVI.

Diseases and Tumors of Breast—Sore Nipples—Inflammation—Abscess—Pathology of Tumors—Hypertrophy—Cancer—Adenoma—Cystic Disease—Excision 679

395. Submammary abscess 672
396. Cystic adenocele 685
397. Solid adenocele 685
398. Hypertrophy of breast 686
399. Infiltrating cancer of breast with retracted nipple 687
400. Ditto with puckering of skin over it 687
401. Tuberous cancer of breast . . 688
402. Section of infiltrating cancer . . 689
403. Section of tuberous ditto . . 689
404. Section of adenocele 690
405. Open cancer of breast 692
406. Ruptured cystic adenoma with protruding intra-cystic growth . . 692

CHAPTER XXVII.

On Ovarian Disease and Ovariotomy—Extirpation of Uterus 695

407. Trocar and canula for tapping ovarian cyst with sliding forceps . . 707
408. Nélaton's cyst forceps 707
409. Omental clamp forceps . . . 708
410. Wells's clamp for pedicle . . . 709

THE SURGERY OF THE MUSCULAR AND OSSEOUS SYSTEMS.

CHAPTER XXVIII.

PAGE
Affections of the Muscles, Bursæ, and Tendons—Contusions—Rupture—Inflammation of Muscle—Atrophy—Tumors—Bursæ, Popliteal—Synovial Cysts—Ganglion 713

FIG. PAGE
411. Rupture of rectus femoris . . . 714
412. Thumb torn out 715
413. Ruptured long tendon of biceps . 716
414. 414A. Chronic inflammation of muscle 717
415. Cancerous tumor of hand . . . 720
416. Semi-solid bursa 722
417. Bursa sloughing from over patella . 722
418. Compound ganglion of hand and forearm 726

CHAPTER XXIX.

Malformations—Deformities—Clubfoot and Orthopædic Surgery 727

419. Types of the different kinds of deformities of the hands and feet . 728
420. Talipes equinus 730
421. Congenital varus 730
421A. Equino-varus 731
422. Talipes valgus, congenital and acquired 731
423. Talipes calcaneus, congenital and acquired . ′. 731
424. Mode of stretching tendons by strapping 733
425. Splint for talipes 733
426. Little's shoe for talipes 735
427. Davies-Colley's splint for talipes . 735
428. Extreme example of talipes equinovarus 736
429. Ditto, as remedied by operation . 736
430. Portions of bone removed . . 736
431. Spurious talipes valgus . . . 737
432. Ogston's operation for genu valgum 737
433. Cap and band for extension in wryneck 739

CHAPTER XXX.

Contusions—Sprains—Wounds—Injuries of Joints and Dislocations . . . 739

434. False joint after dislocation of the head of the femur . . . 742
435. Dislocation of the sternal end of the clavicle forwards . . . 745
436. Dislocation of the scapula . . 746
437. Diagrams of dislocation of the head of the humerus downwards and forwards 747
438. Subcoracoid dislocation of the head of the humerus 747
439. Subglenoid dislocation of the head of the humerus 747
440. Diagrams of dislocation of the humerus beneath clavicle and beneath spine of scapula 748
441. Subspinous dislocation of the head of the humerus 748
442. Diagrams showing mode of reducing dislocations of the head of the humerus by manipulation . . 749
443. Clove hitch 750
444. Reduction by extension of arm upwards 750
445. Dislocation of the head of the humerus associated with fracture . 751
446. Dislocation of the radius and ulna backwards 752
447. Dislocation of the radius and ulna outwards 752
448. Dislocation of the radius and ulna forwards 752
449. Dislocation of head of radius forwards 752
450. Dislocation of head of radius backwards 752
451. Displacement of the lower epiphysis of humerus backwards . . 753
452. Dislocation of the hand forwards . 754
453. Dislocation of the hand and radius forwards off ulna . . . 754
454. Puzzle toy for reduction of dislocation of phalanges . . . 755
455. Levis's apparatus for ditto . . 755
456. Dislocation of the femur on to dorsum 757
456A. Rent in capsule in dorsal dislocation 757
457, 458. Drawings illustrating the ilio-sciatic forms of dislocation of the head of the femur . . . 757
459. Dislocation of the head of the femur on dorsum 758
460. Dislocation into the sciatic notch . 758
460A–B. Diagrams showing shortening of limb in dislocation backwards . 758
461. Dislocation into foramen ovale . 758
462, 463. Drawings illustrating dislocation into foramen ovale and upon os pubis 758
464. Dislocation upon os pubis . . 759
465, 466. Drawings illustrating the method of reducing dislocations of the head of the femur by manipulation . 760
467. Dislocation of the tibia and fibula forwards 763
468. Appearance of foot and ankle in Pott's fracture 764

CHAPTER XXX—*Continued.*

FIG. PAGE
469. Dislocation of foot inwards with fracture of inner malleolus . . 764
470. Dislocation of foot backwards . 764
471. Astragalus driven upwards between malleoli 766
472. Dislocation of foot inwards off the astragalus 766
473. Compound dislocation of the astragalus 767
474. Dislocation of the astragalus outwards, with fracture of the fibula 768
474, 474A. Congenital malformation of hips 769
474B. Ditto of left hip 769

CHAPTER XXXI.

On Fractures 770

475. Drawings illustrating the different varieties of complete fracture . 770
476. Incomplete fracture of clavicle . 770
477. Incomplete fracture of parietal bone 771
478. Impacted fracture of the neck of femur 771
479. Flannel immovable splint . . 777
480. False joint after fracture . . 780
481. Deformity following repair of greenstick fracture 781
482. Fracture of scapula . . . 783
483. Fracture of the neck of the scapula 783
484. Fracture of the head and tuberosities of the humerus 784
485. Impacted fracture of the head of the humerus 784
486. Separation of shaft of humerus from its upper epiphysis . . . 784
487. Fracture of the surgical neck of the humerus 785
488. Splint for fracture of the shaft of the humerus 786
489. Comminuted fracture of the condyles of the humerus 787
490. Arrest of growth in the humerus after injury 787
491. Colles's fracture of the lower end of radius 788
492. Fracture of the lower end of radius and displacement backwards . 788
493. Fracture of lower end of radius and displacement forwards . . 788
494. Comminuted fracture of the lower end of radius 789
495. Splints for fracture of the forearm . 789
496. Gordon's splint for fracture of the lower end of radius (Colles's fracture) 790
497. Radius and ulna consolidated after fracture 791
498. Fracture of the coronoid process and head of radius . . . 791
499. Compound dislocation of ulna and displacement of lower end of radius at its lower epiphysis . . 792
500. Stromeyer's cushion for fracture of the humerus, &c. . . . 792
501. Fracture of pelvis in child, with prolapse of pelvic contents . . 794
502. Comminuted fracture of the pelvis . 794
503. Head of femur driven through acetabulum into pelvis . . . 794
504. Impacted fracture of the neck of the thigh-bone 796
505. Comminuted fracture of the upper part of the femur, from the neck being driven into the shaft . . 796
505A. Drawing showing effects of fracture of the neck of the thigh-bone . 796
506. Ilio-femoral triangle for the diagnosis of shortening of the neck of femur 797
507. Intra-capsular fracture of the neck of the thigh-bone . . . 797
508. Doubly impacted fracture of the neck of the thigh-bone . . . 797
509. Long splint with weight for fracture of the neck of the thigh-bone . 798
510. Double splint for fracture of the femur or hip disease . . . 799
511, 512. Absorption of the neck of the femur after fracture with corresponding healthy femur, for purposes of comparison . . . 799
513. Separation of epiphysis of the great trochanter of femur . . . 800
514. Drawing of ditto during life . . 800
515. Impacted fracture of the shaft of the femur 801
516. Cripps's splint for fracture of the thigh 802
517. Hodgen's splint for ditto . . 802
518. C. de Morgan's splint for ditto . 803
519. Drawing illustrating the treatment of fracture of the femur by vertical extension 803
520. Immovable bandage for fracture of the thigh 803
521. Fracture of the condyles of the femur 804
522. Separation of the lower epiphysis of the femur 804
523. Multiple fracture of the patella . 805
524. Fracture of the patella . . . 806
525. Fracture of the patella united by bone 806
526. Splint for fracture of the patella with elastic compression . . . 807
527. Arrest of growth in shaft of tibia with bowing of fibula, following injury to upper epiphysis of tibia . . 808
528. Splint for fracture of the tibia . 808
529. Splint for fracture of fibula . . 808
530. V-shaped fracture of the tibia . 809
531. Drawing illustrating the process of setting fracture of the leg . . 809
532. Apparatus for fixing and swinging a fracture of the leg . . . 810
533. MacIntyre's splint and Salter's swing 810
534. Nathan Smith's anterior wire splint for fracture of the leg . . 811

CHAPTER XXXII.

PAGE
Diseases of the Joints 814

FIG. PAGE
535. Drawing illustrating the shedding of articular cartilage in articular ostitis 819
536. Necrosis of the head of the femur . 822
537. Separation of the upper epiphysis of the femur 822
538. Apparent elongation of lower extremity from *ab*duction of the femur 823
538A. *Ab*ducted lower extremity in hip disease 823
539. Apparent shortening of lower extremity from *ad*duction of femur . 823
539A. *Ad*ducted lower extremity in hip disease 823
540. Displacement of femora on to dorsum from disease—front view . 824
541. Ditto—side view 824
542. Lordosis in hip disease, with patient erect 824
543. Ditto, effaced 824
544. Lordosis in hip disease, with patient standing 825
545. Ditto, remedied 825
546. Position of lower extremity in neglected hip-joint disease . . 825
547. Synostosis of hip-joint 825
548. Arrest of growth in neck of femur following articular ostitis . . 825
549. Appearance of knee-joint in synovitis 826
550. Appearance of knee-joint in articular ostitis 827
551. Appearance of foot after removal of scaphoid, cuboid, and three cuneiform bones 828
552. Drawing illustrating the amount of flexion in elbow after recovery from disease 830
553. Double splint as applied in hip disease 832
554. Head of femur altered by disease . 833
555. Immovable splint for hip disease . 833
556. Mode of applying extension to lower extremity in hip disease . . 834
557. Anchylosis of hip-joint at right angles 834
558. Position of limb after Adams's operation 834
559. Instruments employed for subcutaneous division of the neck of the thigh-bone 834
560. Drawing showing the line of section of the neck of the thigh-bone in Adams's operation . . . 834
561. Splint for diseased knee-joint . . 836
561A. Bavarian splint, as completed for disease of the knee 836
562. Abscess in head of tibia with necrosis, burrowing into knee-joint . 842
563. Splint for excision of knee . . 845
564. Foot after removal of astragalus . 846
565. Parts removed by resection of the elbow-joint 848
566. Vertical incision for excision of the elbow-joint 848
567. Splint for excision of the elbow . 848
568. Section of loose cartilage removed from knee-joint 851
568A. Microscopical appearance of loose cartilages 852
569. Osteo-arthritis of knee-joint . . 854
570. Osteo-arthritis of head of tibia . 854
571. Changes in hip-joint the result of osteo-arthritis 854

CHAPTER XXXIII.

Diseases of the Bones 856

572. Superficial necrosis of the frontal bone following wound caused by the gnawing of a ferret . . 857
573. Periosteal necrosis of the tibia following periostitis 857
574. Necrosis of the shaft of the tibia the result of endostitis, with shell of new bone surrounding it . . 857
575. External appearance of limb the subject of necrosis, with probes inserted into cloacæ leading to dead bone 857
576. Necrosis of the shaft of the tibia . 858
577. Necrosis of articular lamella of bone 858
578. Sclerosis of bone 858
579. Abscess in head of tibia . . . 861
580. New bone formed beneath periosteum the effects of periostitis . . 862
581. Upper half of humerus separated from the upper epiphysis thrown off by natural processes . . 865
582. Instruments employed in the operation of sequestrotomy . . 866
583. Arrest of growth in tibia after removal of necrosed shaft . . 867
584. Hollow in face after escape of bony tumor 870
585. Tumor as discharged . . . 870
586. Exostosis of femur, with section . 870
587. Periosteal exostosis . . . 870
588. Enchondromatous tumor . . 871
589. Enchondromatous tumor of hand . 871
590. Periosteal sarcoma . . . 872
591. Osteo-chondroma of femur . . 872
592. Ditto during life 872
593. Myeloid disease of femur . . 873
594. Myeloid tumors of bone . . 873
595. Cancer of shaft of femur with fracture 874
596. Periosteal cancer of the tibia . . 874
597. Osteoid cancer of bone . . . 874
598. Epithelial cancer attacking bone . 874
599. Cancer of skin invading bone . 875
600. Hypertrophy and atrophy of bone . 877
601. Section of normal bone . . . 878
601A. Section of bone affected with mollities 878
602. Osteitis deformans 880

CHAPTER XXXIV.

PAGE
On Gunshot Injuries 881

FIG. PAGE
603. Drawings of English and foreign bullets 883
604. Nélaton's probe, Coxeter's extractor, and Lecomte's stylet-pince . . 887
605. Gunshot wound of skull, wound of entrance 888
606. Gunshot wound of skull, wound of exit 888
607, 608. Fracture of vitreous table of skull without fracture of external table 889

CHAPTER XXXV.

Anæsthetics 896

609. Chloroform inhaler . . . 899
610. Anæsthetic inhaler . . . 899
611. Richardson's spray apparatus . . 902

CHAPTER XXXVI.

On Amputation 902

612. Surgeon and his assistants arranged for operation 909
613. Flap amputation of thigh . . 909
614. Thigh stump, with splint . . 910
615. Thigh stump, with splint for extension 910
616. Mode of dressing stump by irrigation with trough and water-can . . 911
617. Teale's amputation . . . 914
618. Carden's amputation through the condyles of the femur . . 915
619. Amputation of the leg by skin flaps and circular division of the muscles 915
620. Stump after amputation of the leg . 916
621. Amputation at the shoulder-joint . 916
622. Amputation through the arm by the flap operation 917
623. Amputation at the elbow-joint . 917
624. Stump after amputation at the elbow-joint 917
625. Amputation of the forearm . . 918
626. Diagram of hand showing joints, as guide to amputation of fingers . 918
627. Hand after amputation of part of thumb, index, and two outer fingers 919
628. Lister's abdominal tourniquet . 920
629. Amputation at hip-joint . . . 920
630. Stump after amputation at the knee-joint 921
631. Diagram of Stephen Smith's method of amputation 922
632. Posterior aspect of stump after S. Smith's method of amputating at knee-joint 922
633. Foot after amputation of the four outer toes, with metatarsal, two external cuneiform and cuboid bones 923
634. Surgical guides to the foot as expressed by its anatomy . . 924
635. Stump after Hey's amputation . 924
636. Chopart's amputation of foot . . 925
637. Stump after Chopart's amputation . 925
638. Stump after Syme's amputation . 927
639. Pirogoff's amputation—heel flap with calcis 927
640. Pirogoff's amputation—division of malleoli 928
641. Stump after Pirogoff's amputation . 928
642. Stump after circular operation of thigh 928
643. Stump after flap operation of thigh 928
644. Stump with patella after amputation at knee-joint 928
645. Conical stump 929
646. Necrosis of a stump 929
647. Bursa over end of stump . . 930
648. Golding-Bird's electrolytic caustic . 931
649. Thomas's splint for hip disease . 931
650. Thomas's splint for diseases of knee 931
651. Ditto, applied 931
652. Invalid lift 932

THE

PRACTICE OF SURGERY.

INTRODUCTORY CHAPTER.

SURGERY is of a twofold nature. It is a science and also an art—one department that requires to be known and another to be practised. The science embraces a knowledge of the character, the causes, and the effects of disease and injury, and also of the processes by which they are best repaired; the art, the treatment of diseases or injuries as they present themselves. The latter, however, in order to be successful, must be based upon science, and science must be supported by observation, at the bedside, where the phenomena of disease must be studied, and the symptoms recognized as well as duly weighed; and also in the post-mortem room, where the effects are to be traced. The great object of the student, therefore, should be clinical and pathological investigation, the study of the living and the dead. It is by this alone he can hope to acquire a solid basis on which to ground his practice.

The external features of a local disease may appear the same to the student as to the most accomplished practitioner; whereas the phenomena of disease are often perceptible to the surgeon alone—the acquired art of observation and the unconscious influence of experience giving to the mind of the one a power of recognition and interpretation which is denied to others.

It is to the acquisition of this power, therefore, that the student should devote his energies, and to this end cultivate the art of observation, for by it he will not only gain the power of seeing correctly, but also of interpreting the meaning of what he sees, and will thereby acquire a diagnostic acumen which cannot otherwise be obtained.

It is now necessary to consider by what method a correct opinion can be formed in any given instance; how sources of fallacy are best eliminated and a good diagnosis established, for it cannot be too forcibly impressed upon a student's mind that the treatment of a case will not be successful unless based on a clear understanding of its wants, and that these can never be duly appreciated where a correct diagnosis of its nature has not been made.

The mind of the surgeon should invariably be judicial, and possess nothing of the advocate, it should be so regulated as to be able to put aside all prejudices and preconceived ideas, suppress the advocacy of all unsupported theories and hypotheses, accept clinical phenomena as they are observed, and arrive at a conclusion cautiously and clearly after duly balancing the facts of the case, and carefully weighing the possibilities and probabilities of its nature.

To form a diagnosis of a case mainly on probabilities as indicated by symptoms may be a ready, but it will always prove a rash proceeding. To form it on possibilities will be a safe, although, perhaps, a less expeditious course. The surgeon who acts upon the first method must, at times, fall into grave errors, although his diagnosis will often appear brilliant and be successful; while he who habitually forms an opinion after taking into consideration every possibility of the case, and comes to a result by a process of exclusion, must surely, on the whole, be more certain in his ends, as he will be safer and sounder in his practice. I lay down therefore the following proposition as a guiding principle of investigation applicable alike to all cases of injury as well as of disease.

That in the diagnosis of a case, every possibility of its nature should be entertained, and a conclusion arrived at by a process of elimination; each possibility should be separately considered and weighed, and the most probable finally accepted; a diagnosis wholly framed on probabilities being most hazardous.

For example, a tumor at the femoral ring may *possibly* be an abscess, an aneurism, or a varix, cyst, hernia, enlarged gland, or a new growth. An abdominal tumor may be ovarian, uterine, peritoneal, vesical, splenic, fecal, renal, or hydatid. Its probable nature will be best arrived at by eliminating each of these possibilities *seriatim* after a due consideration of all its clinical symptoms: the most probable diagnosis being finally accepted on evidence both negative and positive.

With the above great principle of practice as a guide in clinical investigation, I now proceed to consider how an injury or disease is to be investigated, confining my observations to classes of injury and disease. I do not propose, however, to point out here the exact mode in which it is well to examine a case or to report it—for a report is only a written examination—although at pages 21 and 22 an outline will be seen, which may probably be found of service. I drew it out many years ago when surgical registrar at Guy's, where it has been generally followed ever since.

How to Investigate a Case.

When a surgeon is called to a patient, his questions naturally apply first of all to the seat of disease or injury. Is it in the head, chest, abdomen, or extremities? He will then ask as to its duration or when the injury was received? or when was the disease discovered? If a case of injury, his inquiries would tend to elicit the exact mode of its production, the force employed, and the character of the instrument by which it was produced; for these points are of essential importance under all circumstances, and in head injuries they often give the key to the solution of many questions. By these means the exact seat of injury will probably be indicated, and the surgeon will be led to make a close examination of the injured part; but he should never fail to assure himself that all other parts of the body are sound and in working order, and that no other is involved in disease, or is the subject of injury; for it would be a forlorn hope to amputate for a crushed limb when associated with a ruptured liver, or to reduce a dislocated joint when combined with some fatal internal lesion.

In a case of injury to or disease of the head or nervous system, the most important point the surgeon has to determine has reference to the exact seat of the affection. Is it confined to the soft parts covering the bone, or are the contents of the skull in any way involved? because, in the former, the affection is comparatively of small importance; while in the latter, its gravity cannot be too highly estimated. Scalp wounds, however severe, have as a rule a successful ending; whilst brain injuries, however trivial, should always be regarded with apprehension, for they may lead to the most serious complications.

When no signs of brain disturbance after an injury have been observed the diagnosis is not difficult, for without symptoms, local or general, a surgeon may be excused from entertaining the idea of brain complication; although he should know that fatal cases of fractured base have taken place without any symptoms to suggest the presence of such an injury. When indications of brain disturbance exist, the difficulty arises, for it cannot be too firmly impressed on the student's mind that the same symptoms may be produced by concussion as by compression of the brain; and that bone pressing on the brain, and blood effused upon its surface, or within its structure, give rise to precisely the same phenomena; he should know that the symptoms produced by apoplexy the result of a ruptured vessel, and by hemorrhage into the brain from an injury, are almost identical, and that those produced by what is called functional disturbance of the brain closely resemble those caused by organic mischief. Whilst, therefore, it is imperative on the student of surgery to remember, that a variety of different conditions may give rise to apparently identical clinical symptoms; he must know that the clinical *history* of each of these cases will, on inquiry, be found to differ widely, and that it is to the collateral evidence of the case he must look, to find the right clue to a successful diagnosis.

Where no clinical history can be obtained, the difficulties of diagnosis are indeed great; thus, when a surgeon is called to see a man who has been found in the street, insensible; who is in fact in an apoplectic condition, and has, at the same time, some external evidence of injury to his skull; and may perhaps also smell of spirits. The questions that arise in the surgeon's mind under these circumstances are very conflicting. Did this man have a fit and then fall? or, are the symptoms due to a brain injury, the result of an accident? Was he knocked down and injured, or, was the injury the consequence of a fall? Are the symptoms caused by drunkenness, or how far are they complicated with it? Are they the result of blood-poisoning from kidney disease, or, poisoning by opium?

To unravel all these points great care and discrimination are required. Too much, indeed, cannot be bestowed upon the task, because to treat an apoplectic seizure, or a case of severe brain injury from external violence, for drunkenness, is a grave error; but, unfortunately, it is one which is not uncommon. To mistake drunkenness for apoplexy or severe head injury, is, perhaps, a less grave, although it is, without doubt, a serious fault. As a matter of practice, however, it is generally a wise rule to regard all these suspicious cases from the more serious point of view, and to watch and wait for symptoms to indicate the practice that should be pursued.

What I wish therefore to impress upon the student is the necessity of bearing in mind that all these different conditions alluded to present to the surgeon many features in common, and that a correct diagnosis can only be arrived at by a process of exclusion. The possibilities of the case having thus been reviewed, the probabilities can only be weighed by a rigid inquiry, even into the minutest circumstances that can be ascertained.

In cases of local paralysis the difficulties of diagnosis are very great. Is the cause a *central* one—that is, is it in the brain or cord? or is it *peripheral*—at the termination of the nerves? or, is it *local* without being quite peripheral?

If one of the two former causes be in operation, the history of the case will probably form a true guide to the surgeon; and in the latter some local injury to the nerves supplying the part, some tumor or aneurism pressing upon the nerves, will probably be found; or, perchance it may be a case of lead palsy or infantile paralysis. But under any circumstances, a true diagnosis can only be made by eliminating from consideration the many possible causes and adopting the most probable.

Again, *It should be an invariable rule of practice in every case of injury or disease, to compare the sound with the affected side of the body.* In the diagnosis of a dislocation or fracture, the information gained by the comparison is always of great value, and furnishes often to the experienced eye a true suggestion as to the nature of the accident. In joint disease, also, the practice is of equal importance; any effusion into a joint, or enlargement of the bones being, as a rule, readily detected on making the comparison.

The nature of the disease or injury being thus suggested to the mind through the eye, the suggestion remains to be confirmed or corrected by a careful manual examination, by the other clinical symptoms, and by the history of the case; the facts elicited by the sight, by the hand, and by the ear, being made separately available, and the conclusion drawn after a careful balancing of the probabilities and possibilities of the case. The diagnosis will be well established when all these different modes of investigation lead to one conclusion. In surgery as in medicine the student must educate the eye to see and the hand to feel. The task is by no means simple or easy; indeed, it is one of the most difficult to learn, and cannot be begun too early in a professional career. Reading will not help, nor thought aid; personal experience at the bedside alone will supply the want.

To recognize the existence of a wound, or the deformity of a broken bone, may not be difficult; but to read aright the endless phenomena which a wound presents, and to make out the character or tendency of a fracture, requires much experience. To see that a swelling exists in a part is open to the uneducated eye; but to recognize the various aspects that different tumors assume, to make out their form, position, and attachments, to estimate their consistence, to recognize the fluctuation of fluid, whether superficial or deep, and to detect pulsation, require considerable tactile power and long education. What education also is demanded in order to read the phenomena presented in diseases of the eye or the skin! "No study of the written observations of others could enable any to appreciate those endless varieties of the pulse which entirely baffle description, or to distinguish between the warmth of the skin, excited by various accidental causes, and the pungent heat accompanying the first stage of pneumonia, or acquaint him with the shrunk and shrivelled features derived from the long-continued disease of the abdominal viscera —the white and bloated countenance often attendant on changes in the functions or structure of the kidney—the squalid and mottled complexion of the cachexia dependent upon the united effects of mercury and syphilis—the pallid face of hemorrhage—the waxen hue of amenorrhœa—the dingy whiteness of malignant disease—the vacant lassitude of fever —the purple cheek of pneumonia—the bright flush of phthisis—the contracted features and corrugated brow of tetanus; all which shades of countenance, with many more that might be enumerated, are distinctly recognized by the experienced eye." (Dr. Bright, 'Guy's Hosp. Rep.,' 1836.) Yet all this, and something more, is to be acquired by means of trained observation, and no labor on the student's part should be considered too great for its attainment.

The subject of ***Diathesis*** claims the attention of the surgeon, on account of its undoubted bearing on practical surgery. In the ***strumous, scrofulous***, and ***tuberculous diathesis***, all of which appear to be closely allied, there is, no doubt, a tendency to glandular enlargement, the formation of caseous deposits, and a low kind of inflammatory action, whether in the bones, joints, skin, or lungs; but beyond these clinical facts we know nothing. Disease in subjects who have these diatheses is precisely identical in its essential nature with the same disease as found in others who have them not. It may be modified in its course by the diathesis, but it is the same. These names have, likewise, no special signification when applied to local affections.

It is important to bear this fact in mind, for there can be little doubt that the expressions "strumous disease" and "scrofulous disease" have had an injurious influence on the practice of surgery. They have too often led the surgeon (and misled the public) to regard a local affection in a strumous or scrofulous subject as incurable, as depending on some constitutional condition, and not on a local cause. In disease of the joints this error has been much felt, and should be rejected.

The modern investigations of Drs. Sanderson and Fox in our own country, and Dr. Waldenburg[1] abroad, tend, however, to show that the ***scrofulous*** diathesis, in which there is a tendency to inflammation of a low type, gives rise, under some circumstances, to ***tuberculosis***, and that local inflammatory affections of a chronic nature are especially prone to be followed by tuberculous disease. The gray granulations or tubercles are apparently derived from some pre-existing inflammation; from the absorption into the blood of the ***caseous*** or ***cheesy*** deposits which are supposed to be the residue of an antecedent inflammatory action—whether in the bones, joints, glands, or lungs—and these are subsequently disseminated in the form of miliary tubercle. Niemeyer, indeed, maintains that "the formation of tubercle never takes place unless preceded by pneumonia, terminating in caseous infiltration of the pulmonary tissue." To the surgeon this aspect of the case is of immense importance, for it is clearly his duty, under these circumstances, to hasten the recovery of local suppurative disease as much as possible, and where this cannot be carried out, to remove it. For let it be once shown that local disease has a direct influence in producing constitutional dyscrasia—call it by what name we will—and the necessity of dealing actively with chronic local affections becomes a duty. I have occasionally acted upon this principle with the best results, and in more than one case in which there was progressive lung mischief associated with a disorganized knee have found the lung affection speedily subside after amputation. It must likewise be admitted that a local disease in a strumous subject, may be as amenable to treatment as it is in a more healthy one. The treatment may indeed require some modification from the fact of its occurring in such a subject, but the principles of practice in both, the strumous and the non-strumous, are the same, although we know that in the former all diseased action is of a low type, and that there is always a greater tendency to degenerative changes than we find in other subjects. Some pathologists have been bold enough to say that the scrofulous diathesis is the consequence of hereditary syphilis, but evidence is wanting to substantiate this view.

Hæmophilia, or the ***hemorrhagic*** diathesis, is a subject of peculiar interest to the surgeon. That it is generally hereditary there can be no doubt, and in some instances it affects several members of the same family. It is shown by a peculiar tendency to bleeding on the slightest provocation, and by the difficulty there is in arresting hemorrhage when it does take place. The surgeon should always have before him the possibility of his patient being a subject of this diathesis; for although it would not prevent the performance of any operation essential to save life, it would materially affect the question of operating for any reason of expediency, and would influence the practice adopted.

The bleeding may take place from any part of the body, or into any cavity. It may be venous or arterial, and may occur without any definite cause, or follow some slight injury. Sir W. Jenner states that in these cases "the tissues are soft and bruise easily; the blood is slow in coagulating, although it coagulates as firmly as in health; that is, blood is formed rapidly, and there is a tendency to plethora of the small vessels, and that when the patient is looking his best, injuries have the worst effect, and spontaneous hemorrhages are most likely to occur." In this disease, therefore, he advises a mercurial and saline purge every three weeks, dry food, with a considerable portion of dry fibrinous meats, and plenty of open-air exercise; great care being observed to avoid injuries.

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[1] 'Die Tuberculose und Scrofulose,' von Dr. L. Waldenburg. Berlin, 1869.

A few words now respecting *cachexiæ*.

Do they exist? Is there any definite aspect associated with any definite disease? Is there a cancerous cachexia? I have little hesitation in stating that in practice no such thing can be established, and, that a large number of patients suffering from cancer are as healthy looking as any other class, if not often healthier. There can be no doubt that a patient, suffering from cancer which, by its discharges or development, interferes with the important functions of life, and undermines his powers, has an anxious, drawn, bloodless, and waxy appearance; but so has the subject of any organic disease which interferes with the functions of digestion and assimilation, and particularly the subject of intestinal disease. The patient exhausted by suppuration, by spinal, bone, or joint mischief; the man or woman who from drink, syphilis, or mercury (separately or combined), is gradually being brought down to death's door, has a cachexia more or less peculiar according to the organ involved in the disease, and the special constitution of the patient; but it is merely the condition of looking ill. Clinically, I read the meaning of a cachexia as "looking ill," perhaps very ill, from some long-standing or slowly-acting cause; but it has no other definite signification than "looking ill" from cancer, "looking ill" from abdominal, rectal, suppurative, or syphilitic disease.

POINTS FOR INQUIRY IN SURGICAL CASES.

Disease or Injury. **Date when seen.** **Result.**

NAME, age, occupation, residence, general health, habits, and aspect. In some cases hereditary history.

HISTORY OF PRESENT DISEASE OR INJURY.—Its assigned cause or method of production.

ORDER OF SUCCESSION OF SYMPTOMS, with their former treatment, and date of any marked change in either symptoms or treatment.

PRESENT CONDITION AND APPEARANCES; passing in review, and noting when irregular the condition of intellect, senses, and nervous system. Organs of respiration and circulation. Pulse—frequency, force, volume, compressibility, distinctness, and rhythm. Temperature. Digestive Organs—tongue, appetite, bowels. Urino-genital Organs—urine, catamenia. Integuments—eruptions, moist or dry;—above or below natural heat. Locomotive organs—bones, joints, and muscles, whether paralyzed or in undue action.

PREVIOUS DISEASES OR INJURIES, with their dates. Treatment.

PROGRESS OF THE CASE.—Note carefully any change in the old, or the appearance of new symptoms, with the date of change, and treatment, by medicine, diet, &c. &c. Carefully fill in the result, and date of departure; if unfavorable, the condition on post-mortem examination.

NOTE.—As the value of a Report depends upon its conciseness, together with the accuracy and number of recorded observations, it is unnecessary to write one, unless an appreciable change in the symptoms exists.

SPECIAL POINTS FOR OBSERVATION.

HERNIA.—Variety and character—its position, period of existence, assigned cause, and form; whether previously irreducible, and if a truss had been worn.

When STRANGULATED, give the symptoms, *general and local*, dating from the exact period of strangulation, the first appearance of sickness, character of vomit.

PREVIOUS AND PRESENT TREATMENT.—If by *taxis*, state whether forcible, and how long applied, with or without chloroform; when by *operation*, if sac was opened or not—if opened, *why?* its contents and their appearances. On reduction, note the time from the first symptoms of strangulation; success, immediate and final.

WOUNDS.—Variety, position, extent, and depth; how, and with what produced; *when on scalp*, if exposing bone. Complications—hemorrhage, &c. Treatment and result—whether united by adhesion or granulation.

TETANUS.—Idiopathic or Traumatic, partial or general; time of appearance after injury; position and condition of wound. Death—whether from spasm or exhaustion.

DISLOCATIONS.—Form and position; simple or compound; how and when produced; previous Treatment.

SYMPTOMS, general appearance and position of the limb; mobility, pain, amount of injury to soft parts. Treatment—time after injury; by manipulation or extension; mode of application of extension; its direction, duration, and additional means, under chloroform. Result, immediate and final.

FRACTURES.—Simple or compound; how and when produced; position and direction of the line of fracture; its tendency; amount of injury to vessels and soft parts; in *Compound*, note position, and extent of wound; if produced by the primary force or broken bone, what vessels, nerves, or joints are involved. Constitutional symptoms.

TREATMENT.—Sand bags, starch bandage, splints, form of splint applied; date of application. Note the date of any change of local or general Treatment.

FRACTURED SKULL.—Position; kind of injury and direction of the force; if attended by hemorrhage, its amount, and whether from nose, mouth, ear, or external wound. Give evidence, if any, of brain mischief.

IN SUSPECTED FRACTURED BASE.—Paralysis of facial nerve; flow of blood or serum from ear, with the time of its first appearance after the injury and its duration; condition of hearing; state of vision, and of pupils; presence of subconjunctival hemorrhage. If complicated with internal injury, as *concussion, compression, &c.;* carefully report symptoms in their order of succession, and whether immediately following the injury or not; the duration, and amount of unconsciousness, insensibility; paralysis, its position, motion, sensation, or both; condition of sphincters; character and number of pulse, respiration; condition of skin. Treatment, &c.

DISEASED BONE.—Part affected; duration; cause, as external injury, syphilis, mercury; extent, superficial or deep, partial, or general; previous Treatment, especially as regards operations.

Present Symptoms and Appearances.—Condition of dead bone or *Sequestrum*, fixed or loose; number and position of openings, or *external cloacæ*, with the date of their first appearance.

Treatment.—If by operation, its immediate success.

DISEASES OF JOINTS.—Part affected; date of first discovery; assigned cause, as injury. Note the early symptoms, in the order of their appearance; and date of any fresh symptom or marked change; if pain or uneasiness preceded swelling, or was coeval with it; if the former, how long? Rapidity of progress; previous Treatment, and its effects.

Present Appearances.—Position of joint; if flexed, the angle of flexure; size and shape.

Character of Swelling.—Uniform or bulging; manipular indications, hard, soft, elastic, or fluctuating; mobility, amount; if attended with grating, &c.; in the knee-joint, note if the patella be free or not; if free, the sensation felt on moving it; condition of skin; if fistulous openings exist; their position, number, and character of their discharge; deep or superficial; note the date of their first appearance, and if natural or artificial. Pain, acute or gnawing; its position, general or local; if aggravated by motion, or interarticular pressure; if increased at night. Sleep, if disturbed by crying or starting of the limb; sympathetic pain, and its position; condition of muscles of limb; constitutional symptoms. Treatment.

STRICTURE.—Organic or traumatic; duration and assigned cause, especially as regards gonorrhœa; use of injections, or accident; if previously treated by Catheter; complications, as abscess, fistula, with their position and date of appearance.

RETENTION.—Mention period of retention; preceding symptoms, and cause, as stricture, calculus, paralysis, abscess, prostatic disease, &c. Constitutional and local symptoms; previous and present Treatment; puncture per rectum, note the date of removal of the canula and arrest of the flow of urine through the wound.

EXTRAVASATION.—Cause, over-distension or accident; duration of retention before urethra gave way, and period that elapsed before being seen. Describe the appearances and extent of parts infiltrated; constitutional symptoms and Treatment.

VENEREAL DISEASE.—Chancre, duration; Position; glandular, urethral, coronal, or frænal—external, internal, or fringing preputial; character, indurated, non-indurated, aphthous, raised, excavated, irritable, phagedænic, or sloughing; tubercle; condition of inguinal glands, indurated or inflamed. *Previous Treatment*, particularly as regards mercury.

Complications.—Note the date of appearance, and situation of each or any of the complications; the order and time of their occurrence after the primary sore. Present appearance and Treatment of each.

Gonorrhœa.—Date of contraction; former treatment, especially as regards injections, copaiba, &c. Complications, and their duration; in epididymitis, if following suppressed discharge; use of injections, copaiba, or violent exercise.

STONE IN BLADDER.—When discovered; date of earliest symptoms; if preceded by the passage of sand; amount of irritability of bladder; character of urine; constitutional and local symptoms. Treatment—Lithotrity or Lithotomy; in latter, note any peculiarity; date of arrest of the flow of urine through the wound.

TUMORS.—Date of discovery and size; rapidity of growth; general and local symptoms, in their order of appearance. General health, prior to discovery, and since; hereditary tendency; assigned cause; depressing influences. In Mammary Tumors, number of children; date of birth of last; if ever suckled with affected breast, when; condition of the catamenia, if ceased, how long? Previous Treatment, and success.

Present Condition and Appearances.—Position of tumor; size, shape; external aspect and condition of skin; Pain, and its character; condition of lymphatic glands; manipular indications; mobility, when in breast, whether moved by traction of the nipple; Feel, hard, elastic, &c. &c. Constitutional symptoms.

Treatment.—In recurrent growths, give the date of former operations; date when healed; and of its first reappearance, and position.

OPERATIONS.—Describe position, direction, and number of external incisions; the steps of the operation as performed; its duration; number of vessels tied or twisted, and amount of hemorrhage. In Amputations, the part amputated, and position of amputation. In Flap operations, give the position of the flaps; whether anterior, posterior, or lateral; whether performed by perforation or external incision. In the combined flap and circular, note the position of the skin flaps; in all, note the result and character of stump.

CHAPTER I.

ON REPAIR AND INFLAMMATION.

THE repair of wounds after injury is a subject of so much importance that I have thought it well to devote an early chapter to its consideration; for, as in practice, the surgeon's aim is to place wounded parts, whether hard or soft, in the most favorable position for repair, and to remove all obstacles that are likely to interfere with the natural evolution of the process; so is it incumbent upon him to know how nature proceeds in carrying out her end, in order that he may in no way by acts of omission or commission interrupt the performance of that desirable object.

Before entering into details, it is also well to know, as a primary truth, that the processes of repair are identical in all tissues; that the reparative process in bone or muscle, integument or tendon, soft or hard parts, is the same, such modifications alone showing themselves as necessarily appertain to the anatomy of the tissue or special circumstance of its position. Thus, tissues that are highly vascular may undergo more rapid and more perfect repair than others less fortunately circumstanced, and bone tissues may require more time to unite than skin, yet in all the process is alike. Let us therefore inquire what the process is, and see what changes take place in parts undergoing repair; and then look at them where they are best seen, when an incision is made through the skin and the edges are brought together.

The chief points that can be observed have reference to the capillaries. In these, at the margin of the wound, the blood will be found coagulated up to the nearest anastomosis, and the capillary vessels in the neighborhood will be seen dilated—this dilatation being caused by the increase of pressure to which the capillaries have been subjected by the altered circulation of the blood in the immediate vicinity of the wound. When wounds unite by *immediate union* no other changes than these take place, beyond the gradual restoration of the capillary circulation through the parts that have been divided, and under these somewhat rare circumstances no scar or cicatrix is left. The soft parts at first simply adhere together, and consequently become continuous.

Should the wound unite by what is called *adhesive union* or *primary adhesion* (the "first intention" of John Hunter), in which a cicatrix is formed, other changes are to be seen; and these take place in the connective tissue—in which the vessels of the part ramify—a tissue that pervades every other, and which is made up of cell elements and intercellular tissue, the cell elements varying according to the nature of the part in which it is found.

These changes consist of cell multiplication, and, under the circumstances supposed, we find between the edges of the wound a vast accumulation of cells, filling up in various degrees the spaces of this wounded tissue, and, through these cells cicatrization takes place.

Whether this cell multiplication depends upon changes in the cell itself, as Virchow affirms, or whether the cells are the white corpuscles of the blood which have escaped by exudation from the capillaries, as Cohnheim would lead us to believe, I do not now care to inquire. All admit, however, the multiplication of cells in the affected tissues (*vide* fig. 1). Professor Redfern writes (address at British Association, 1874), "the facts must be recognized; the floating blood-cells are really the very cells which once formed the substance of the lymphatic glands, the spleen, and other organs; and they do, in fact, move through the walls of the blood passages, and wander about freely in what are called solid tissues." When we recollect how penetrable the tissues of an animal are, we shall cease to be startled at seeing those parts become the seat of entirely new deposits, or finding them traversed by migrating blood-corpuscles as freely as a colloid is penetrated by a crystalloid.

Let us now inquire briefly how cicatrization proceeds, and note that it is in the cells that the most important changes are to be recognized. Those nearest the injured part gradually assume a spindle shape, and the intercellular tissue into which these spindle-shaped cells are infiltrated becomes denser. The spindle-shaped cells then gradually change into ordinary connective-tissue corpuscles, and in this way new cicatricial tissue is formed. This new tissue, however, again undergoes changes—changes of consolidation. The intercellular tissue becomes gradually more condensed—the spindle-shaped cells also assuming the flat shape of connective-tissue corpuscles, and in a measure disappearing, the nucleus alone remaining—the fluid that existed in the newly-formed tissue is absorbed, and the new cicatrix by degrees thus becomes firmer and denser, gradually contracting, so that at last the delicate scar of a large wound becomes solid and compact—the cicatrix in smaller wounds appearing only as a thin red, and at a later period as a white line.

FIG. 1.

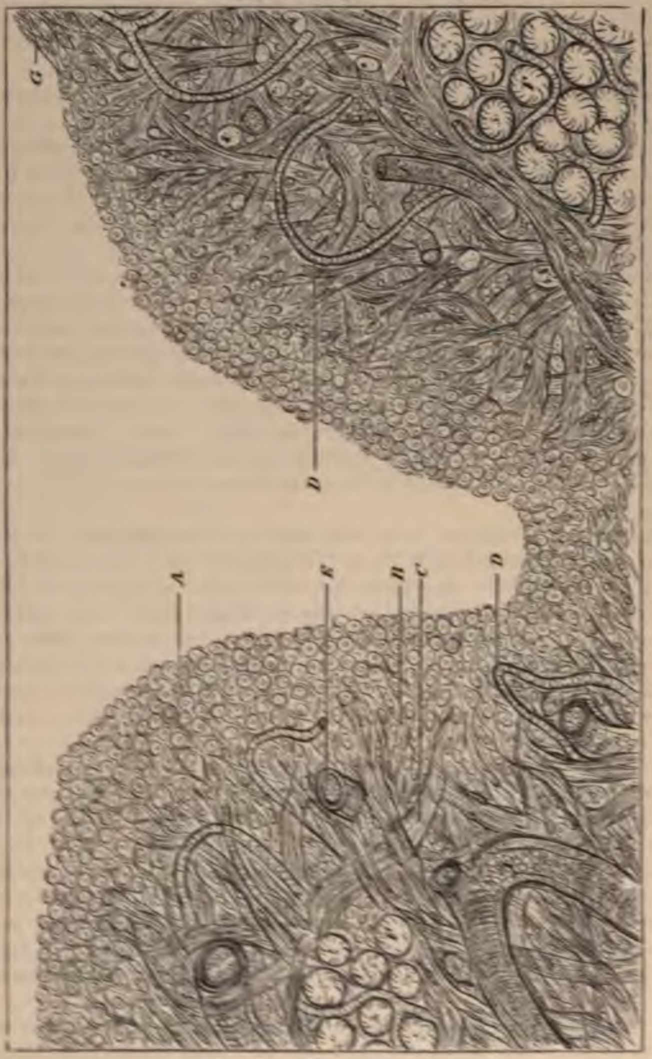


DIAGRAM ILLUSTRATING THE PROCESS OF REPAIR IN A WOUND FILLING UP BY GRANULATION.

A. Granulation-cells with single or double nuclei. These, when shed, are pus-cells. *B.* The same cells becoming spindle-shaped. *C.* Intercellular element becoming developed into bundles of white fibrous tissue. *D.* Capillaries. *E.* Small arteries. *F.* Fat vesicles forming lobules. The two last structures constitute part of the original subcutaneous tissue. *G.* Superficial cells becoming converted into epidermal scales.

(This drawing has been made for me by my friend, Mr. Howse, from microscopical sections of granulations in his possession.)

Changes in the capillaries of the part are, however, going on during all this period, and how far *all* the changes that have been briefly described are due directly to the capillary action is not yet determined. If Cohnheim's views be adopted, it is to the capillaries that the chief action in the tissues must be ascribed. According to those of pathologists, such as Virchow and Billroth, the capillary action takes a secondary place, the cell elements the leading one. But on either theory the importance of the capillaries cannot be overlooked.

With regard to the changes in the capillaries, it has been already pointed out how at the beginning of the reparative process those of the part become sealed, and the collateral circulation in the neighborhood becomes irregular and pressed upon; and how the coagula in these obliterated capillaries become reabsorbed or possibly reorganized as repair progresses. It is certain that the capillary network soon becomes continuous through the newly-formed cicatricial tissue, the capillary meshes of the one side joining, by loops projected through the new tissue, the same meshes of the opposite one.

What influence the nerves of the part have upon the reparative process we do not know. That they have an important influence there can be little doubt, since all physiologists recognize their power upon secretion and nutrition; the vaso-motor nerves doubtless have the greater power. But we must learn something more of nerve power generally and nerve distribution—something of the way in which the nerves terminate in the tissues, and what relation they bear to the capillaries—before we can hope to find out or understand the exact influence nerve supply has on repair.

All wounds do not, however, heal by immediate union, or by primary adhesion, *i. e.*, first intention, and wounds that gape cannot so unite. The process of repair in these, therefore, differs somewhat in its character from those we have been considering; it *takes place by granulation*, or the "second intention" of Hunter. If we closely examine the surface of a wound thus exposed, we shall find that it becomes within a few hours of its exposure covered with a film of a peculiar gelatinous, grayish-white appearance. This will be seen with the aid of the microscope to be composed of granulation-cells or white blood-cells. If the edges of the wound are then brought together, union may take place, this form of healing being termed *secondary adhesion*. After an interval of some hours the parts covered with this gelatinous grayish film become more vascular, as indicated by redness, and the surface more even. The film itself assumes a tougher character, and a yellow fluid, which is mixed with small yellow sloughs of fibrinous tissue, is secreted. The wound begins "to clean," and to have a smooth and consistent surface. After the lapse of another day, or some days, perhaps, this surface is covered with a number of elevations, known by the name of *granulations*, varying in size from a millet-seed to a hemp-seed, the smaller being highly vascular and red, the larger being, as a rule, paler and more bloodless. The wound at this time is "granulating." The secretion from these granulations is now of a creamy-yellow character, and is called *pus*. They are made up of cells called granulation-cells, and resemble inflammatory lymph-cells. Each granulation contains a vessel, the walls of which consist of a thin membrane, in which nuclei are imbedded. "Some of these nuclei are arranged longitudinally, others transversely to the axis of the vessels. In the development of these vessels changes occur, answering to those seen in ordinary embryonic development. Organization makes some progress before blood comes to the very substance of the growing part: for the form of cells may be assumed before the granulations become vascular. But for their continuous active growth and development fresh material from blood, and that brought close to them, is essential. For this the bloodvessels are formed, and their size and number appear always proportionate to the volume and rapidity of life of the granulations. No instance would show better the relation of blood to an actively growing or developing part than in one of the vascular loops of a granulation imbedded among the crowd of living cells, and maintaining their continual mutations. Nor is it in any case plainer than in that of granulations that the supply of food in a part is proportionate to the activity of its changes, and not to its mere structural development. The vascular loops lie imbedded among the simplest primary cells, or when granulations degenerate among structures of yet lower organization; and as the structures are developed, and connective tissue formed, so the bloodvessels become less numerous till the whole of the new material assumes the paleness and low vascularity of a common scar." (Paget.)

If, at this time, when the granulations have attained to the level of the skin, we look to the margins of the wound, we shall see a dry red band of newly formed tissue, with an outer border of a bluish-white color, where it comes into contact with sound integument. This band is the new skin forming, and is caused by the gradual growth of the epidermis from the margin of the sound skin towards the centre of the sore. Such a process is called *cicatrization*. The cicatrix is at first red, as in the linear cicatrix to which we have already alluded, but, as it then contracts, subsequently it becomes paler, more compact, and adherent. The nature of the scar or cicatrix varies with the tissue in which it is formed, the new connecting medium or cicatrix under all circumstances having a powerful tendency to adapt itself to the peculiar character of the tissue in which it is placed. Thus, a cicatrix in skin in time closely resembles true skin, a cicatrix in bone true bone, and in a tendon it becomes tough and hard, like tendon; the consolidating reparative material in every instance partakes of the character of the parts which it connects. It is corpuscular in its origin, and clearly fibrinous in its nature; but whatever the origin may be (though there is considerable divergence of opinion about it), its existence is undoubted, and through it and by it all repair takes place.

When wounds *heal by scabbing*, granulations do not form. In this process the reparative material which is poured out undergoes at once similar changes to those already described as taking place in adhesive union, and the wound cicatrizes rapidly beneath the scab; for the serum of the blood when effused on the surface of a wound is of a highly plastic character, and rapidly coagulates to form a film of a protective nature, under which repair may rapidly proceed. Advantage is taken of this fact in the treatment of superficial wounds; the value of felt, cotton-wool, or any similar material, when applied to an open wound, entirely depending upon this plastic property of blood. Repair by scabbing is doubtless the best form of healing, although it is, unfortunately, somewhat rarely obtained.

The *healing of subcutaneous wounds* must be somewhat similar. Some details of this process will be given in the chapter on Tendons.

I propose now to consider some of *the causes that interfere with repair*, amongst the most frequent of which I would place hemorrhage. Blood, if effused to any extent between the edges of a wound, greatly interferes with the reparative process, and not only forbids all healing by immediate union, but interferes with healing by primary adhesion. If effused in very small quantities between the divided surfaces, it may at times possibly change into cicatricial tissue, and form a bond of union between the divided parts, and in certain other instances it may organize, as on the brain; but if effused to any great extent it will, in all probability, eventually break up and act as a foreign body, causing irritation and inflammation.

If *foreign bodies* exist between the edges of a wound, union cannot go on.

If *the wounded parts are much contused*, union can only take place by granulation or secondary adhesion.

If *the edges of a wound are allowed to gape*, or have too much tension upon them, the same observations apply.

If *the injured parts are not kept quiet*, repair cannot go on, as is well exemplified in fractures.

If *too little action* is present from deficiency of power, as is seen in the very old and the very young, in plastic operations and the non-union of fractures, &c., union cannot take place; and a like result ensues when *too much action exists*.

This leads me now to consider what too much action in a wound means; how it is to be recognized clinically and pathologically; and what are its results.

It is commonly known by the term *inflammation:* and as this process, whether it affects a wound or any other part, has the same symptoms, I shall speak of it generally. As it affects a wound, so it affects the tissues when unattended by a wound; consequently the consideration of its phenomena in the one case will illustrate the other.

The Phenomena of Inflammation.

When *a wound is inflamed* there are four points that arrest attention. The first is *redness*, which appears as a mere blush on the edges of the wound, or may extend far and wide all around. It is either of a bright red color or of a livid hue—the former tint indicating a healthy or *sthenic*, the latter (evidencing want of power), an *asthenic inflammation*. The redness is doubtless due to the capillary injection of the part; and, as we have already seen that in the repair of wounds capillary injection is a necessary attendant, so the redness of inflammation in a wound is simply the result of this carried to excess. The second is clearly connected with the first, indeed, it may be regarded as a result. It is *increase of heat in the part:* increase of action, as indicated by excess of vascularity, being generally accompanied by this symptom. There is reason too for believing that the blood is also overheated. The third is also striking, and is clearly a result of the capillary injection, to which notice has just been drawn. It is the *swelling of the inflamed part*, which shows itself either as a simple œdema of the edges of the wound, or a more or less general, diffused infiltration of the parts. This swelling is apparently due to blood stasis, and is produced by the passive exudation of the serum of the blood into the cellular tissue of the inflamed part, from the stagnation of the blood in the overloaded capillaries of the injured tissue. The fourth is *pain*, which symptom varies much as to its intensity, and apparently depends a great deal upon the amount of swelling and tension in the inflamed part. In inflammation of the bone, periosteum, or any unresisting fibrous tissue, as the coat of the testis or the sclerotic of the eye, the pain is intense; in rheumatism in which the fibrous structures of the joints are inflamed, it is also marked. Probably it is caused by direct pressure on the extremities of the nerves of the swollen tissue. It may be simply an increase of sensibility of the part or may amount to severe agony.

We thus have ***redness***, ***heat***, ***swelling***, and ***pain***, as symptoms of over-action of a part, or of what is called ***inflammation***, and they, one and all, appear to be direct consequences of extreme capillary vascularity of the tissue, whether that be the result of a wound or not. They may manifest themselves in every degree of severity, their extent depending upon the intensity of the inflammatory action and the nature of the tissues that are involved. When a loose tissue is involved, the redness will be much marked, and the swelling will probably be rapid, but the pain will certainly be slight, as the tension of the part is rarely severe. When the connective tissue situated beneath a dense fascia or skin is involved, the redness and the swelling are, as a rule, but slight, since the peculiarities of the part affected prevent their being manifested; but the pain will probably be severe, for the tension of the tissues, and the pressure upon the nerves of the part will, under such circumstances, be necessarily great.

When the inflammation is ***acute*** or rapid, all these symptoms manifest themselves with great rapidity, and the results of the action are quickly shown; when it is slow or ***chronic***, they are less clearly marked.

With these local symptoms of inflammation there will always be associated some ***disturbance of the function of the inflamed part***, or probably its arrest; and what is of equal importance, some constitutional disturbance, which is known as ***inflammatory fever***. This fever may manifest itself in all degrees of severity, its intensity depending much upon the character of the inflammation and its seat. When a local affection is ***acute***, or of a ***sthenic*** nature, the constitutional disturbance will be severe; when ***chronic*** it will probably be mild; and when ***asthenic*** it will be marked by great depression. It may show itself, therefore, only as a slight febrile state, or it may be marked by the severest symptoms.

The following description may be accepted as a type of the affection. I have taken it from Simon's masterly article in Holmes's 'System of Surgery,' 2d edition, vol. i, p. 21:—

"Taking, for instance, a case of severe compound fracture, without much hemorrhage, in a person otherwise sound and strong, we find that, before twenty-four hours have elapsed from the time of injury, his general system begins to be thus affected. He feels hot, or alternately very hot and chilly. His skin and lips and mouth are dry. He passes urine in less quantity, but of a higher color, than usual. His pulse is quickened. A sense of general disorder gains upon him. He becomes restless and intolerant of disturbance. Signs of drought increase with him. His urine becomes scantier and more colored. His skin feels hotter to the Surgeon's hand, and his pulse, whether full or hard, is quicker and stronger than before. He craves more and more for water. His face has a flushed, anxious look. He is thoroughly uncomfortable; for the most part feeling distressingly hot, but at irregular intervals feeling touches of chilliness—sometimes even ot such cold that he shivers with it. His sleep is troubled and unrefreshing; or, as night comes on, he gets delirious. His tongue, besides being dry, is furred. If his bowels act (which commonly they are inapt to do without laxatives) the excretions are morbidly offensive. Gradually these symptoms give way; in proportion as the injured limb ceases to be tense, and passes into suppuration, the skin and mouth become moist again; the excretions lose their concentrated character; the hard pulse softens, and the heart's action becomes quiet; the nervous system is no longer restless; the look of trouble passes from the countenance, and the patient can again take solid food."

There can be little doubt that these symptoms are clearly due to an increase in the temperature of the blood, and that their severity is measured by it. This is, indeed, as Simon has so aptly expressed it, "the essential fact of inflammatory fever. It is to this fact that the familiar language of feverishness bears witness—the thirst, the scanty urine, the heat, and the shivering, the troubled brain, the excited circulation. As the blood gets hotter and hotter, more and more do these symptoms become developed. As the blood subsequently gets cooler, so, more and more do they decline."

The average temperature of the healthy human body according to Jürgensen (Leipsig, 1873) is 98·9° F. or 37·2° C., but the range between, 97 and 99, is quite consistent with health. A febrile condition arises from an increase of temperature accompanied by more or less constitutional disturbance.

It seems from Dr. Montgomery's observations, made for Mr. Simon, that "febrile excesses of bodily temperature range perhaps to ten degrees above the normal heat of the blood; the 'crisis' of a febrile state consists in a rapid and generally continuous reduction, the 'lysis' in a slow and generally discontinuous reduction, of this abnormal temperature." With respect to the causes of this greater heat of blood, it is probable that the fever originates in the tissues themselves, and is a disorder of protoplasm; the results of inquiry showing "that either continuously during the intensity of feverishness, or else more abruptly when feverishness begins to subside, there can commonly be traced in the excretions an excess, more or less considerable, of those nitrogenous, sulphurized and phosphorized products which emanate from textural and humoral waste; that this increased elimination is observed even when ingestion has been reduced to a minimum; and that febrile excretions do, therefore, as a rule, undoubtedly attest an increased devitalization of bodily material." The febrile process is then clearly a disorder of nutrition, in which in man the exchange of nitrogen exceeds the normal expenditure by nearly three quarters, and in which there is likewise an excessive discharge of carbonic acid. The discharge of nitrogen is evidently due to the disintegration of tissue or possibly of blood. This fact explains the rapid waste of body which takes place in fever. The blood coagulates with what is generally described as a "buffy coat," and it seems highly probable that, under these circumstances, it contains more than its normal complement of fibrin. There is good reason also to believe that this "buffy coat" is due to the fact that the blood-corpuscles subside in the liquor sanguinis during coagulation, leaving the upper portion of the clot colorless. What this increase of fibrin in the blood in inflammation means is a question that remains to be decided. Some pathologists believe that the blood is excellent in proportion as it is fibriniferous; that solidifying fibrin is almost incipient tissue; that the fibrinous crust, as drawn in inflammation, is the sign of its being specially adapted to the purpose of additional growth; while Simon, with others, holds "that the blood yields more fibrin, not in proportion as it is ripe and perfect, but rather in proportion to quite opposite conditions; that an increased yield of fibrin portrays not perfection, but post perfection in the blood; that it corresponds not to the rise, but to the decline of albuminous material; that the relations are not with repair, but with waste; that its significance is that of something intermediate between life and excretion; that the fibriniferousness of the blood is undiminished, probably even increased by bleeding; that it is greatly developed during starvation, during violent fatigue, during diseases essentially anæmic; that its increase, under these circumstances of exhaustion, weakness, and inanition, is to the full as great as its increase during inflammation."

"These latter views seem to be most in accord with truth and with the general chemistry of inflammatory fever. They seem to indicate that the fibriniferousness of the blood in inflammation represents action of devitalization and decay in some albuminous material. Whether this changing material be the inflamed texture gradually dissolving itself into the blood, or be the albumen of the fevered blood itself undergoing accelerated waste, cannot in the present state of knowledge be even approximately stated." (Simon.)

With this brief description of the phenomena of inflammation and inflammatory fever, I propose next to consider the effects *of inflammation*, or excess of action, on a given part.

The Effects of Inflammation on a Part.

When inflammation attacks a wound, or excess of action exists in it, repair is interfered with, retarded, or destroyed, in proportion to the intensity of the inflammation; because anything like inflammation of the part is fatal to the immediate union of a wound, as it is to healing either by scabbing or secondary adhesion. In primary adhesion and in healing by granulation, an inflammation sufficient to lead to the pouring out of plastic reparative matter (the granulation tissue of Virchow, embryonic tissue of Rindfleisch) is not injurious; but it must not go beyond this point.

When acute inflammation attacks a wound either of the soft parts or of bone, there is an end to all repair, and partial union may be changed into complete disunion, or the inflamed tissue may wholly or in part die. When soft tissues die in mass they are said to *mortify;* when this action is spreading it is called *gangrene*, or *sloughing phagedæna;* and the dead part thrown off is known as a *slough*. The death of bone is called "*necrosis*," and the dead piece of bone a "*sequestrum*." When a portion of tissue dies, the dead is separated from the living piece by a process known as that of *ulceration;* when the ulceration spreads, an *ulcer* is said to exist; when this undergoes repair, it does so by *granulation*. Ulceration of a part means its molecular death.

There is, however, a low or asthenic form of inflammation found in subjects of feeble and depressed powers which differs in a measure from that which we have been considering. It usually comes on at some late period of the healing process, and manifests itself by clinical phenomena of a subdued character. Redness will be present, although it will not be of a vivid, but of a dull and dusky character; swelling, too, will exist, but it will be of an œdematous kind; the pain will be dull, and the discharge serous or sero-purulent. It affects repair as injuriously as the more sthenic form.

Such, then, are the chief local effects of inflammation on a wound; but there are others of no little importance to which attention must be drawn, the principal one referring to inflammatory exudation into a part.

We have already stated that when inflammation attacks a tissue, swelling is one of the chief clinical signs, and this, without doubt, is directly caused by effusion. The character of this effusion also varies with the activity, character, or specific nature of the inflammation. When the inflammation is of a healthy or *sthenic* kind, it will tend towards the fibrinous variety, producing plastic infiltration of the part; when of a feeble or *asthenic* form, the serous and corpuscular elements will predominate. In the former the soft tissues will appear firm and dense, and in the latter soft and œdematous.

In healthy subjects this plastic material may be re-absorbed, and the tissue into which it had been infiltrated left perfectly sound—recovery then taking place by what is termed *resolution;* in exceptional instances it may become organized. In unhealthy subjects the infiltrating material may break up or degenerate, and give rise to what we know as *pus.* When this forms in a part, *suppuration* is said to have taken place. Inflammatory lymph may consequently be converted into pus. Sir J. Paget has pointed out how, in amputating through a limb infiltrated with lymph, pus may flow from the wound in the course of a day, while it is known that in amputation through healthy tissue free suppuration does not usually appear till after three or four days. Under these circumstances the pus must have been formed by the conversion of the inflammatory lymph previously infiltrated into the divided tissues.

"When an inflamed part is cut, the first pus is from lymph; the latter pus—when repair is in progress—from granulation substance. In both cases alike the pus manifests itself as a rudimental substance, ill-developed or degenerated; and the transition from one condition to the other is an evidence of the impossibility of exactly defining between the inflammatory and reparative processes, unless we can see their design and end." "From these and like facts," says Paget, "we have an almost exact parallel, in their relation to pus, between the material for repair by granulation and that produced in the inflammatory process, and between, if they may be so called, the reparative and the inflammatory suppuration."

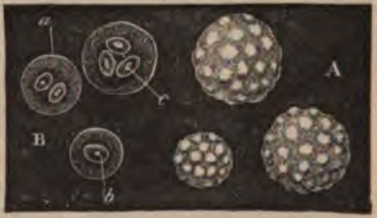
Dr. Burdon Sanderson's investigations, as given in 'Holmes's System,' have led him to regard inflammation as due to excessive irritation of the tissues, this irritation setting up, 1st, disorder of the circulation; 2d, transudation of blood constituents; and, 3d, alteration in the nutrition of the inflamed parts.

Stasis of blood in the inflamed parts is the first effect of inflammation; this stasis which is attended by the crowding together of the white corpuscles or leucocytes, being followed by their motion, their subsequent passage through the capillary walls, and their accumulation in the tissues. The serum that exudes with the leucocytes gives rise to swelling, the leucocytes themselves forming the first purulent elements in the tissues. Cohnheim, indeed, considers these leucocytes as the sole source of purulent infiltration; but the facts before given fairly show that this cannot be the case, pus being probably a compound fluid of leucocytes and degenerated inflammatory tissue.

Pus itself is made up of a thin transparent fluid and pus-corpuscles. These corpuscles are globular, and larger than the white corpuscles of the blood. They are minutely dotted, and contain three or four small dark nuclei which become clear by the addition of acetic acid, and nucleoli (*vide* fig. 2). Acetic acid dissolves the nucleus of a white blood-corpuscle.

Pus is also soluble in alkalies, and has an alkaline reaction. It contains from fourteen to sixteen per cent. of solids—chloride of sodium and phosphates. Dr. Day, of Geelong, has given us a new test for pus that is worthy of record. He prepared his test-fluid by exposing a saturated alcoholic solution of guaiacum to the air until it had absorbed a sufficient quantity of oxygen to give it the property of turning green when placed in contact with iodide of potassium. On moistening the smallest quantity of pus with water, and pouring a drop or two of the test-fluid over it, a clear blue color was produced.

FIG. 2.



A. Pus-corpuscles (magnified 350 diameters). B. Same made transparent with acetic acid. *a.* Cell-wall. *b.* Nucleus. c. Nucleolus. (After LEBERT.)

By means of this test he has made out that healthy pus, when dried, becomes chemically inactive, and non-susceptible to the test, although when moistened with water, it resumes its chemical activity; whilst pus taken from an erysipelatous, carbuncular, or pyæmic patient, retains for many months, although dry, its chemical activity, and responds to the test at once. He believes, consequently, that a moist atmosphere promotes and that a dry retards the spread of erysipelas and allied affections. He finds that carbolic acid destroys for ever the chemical activity of all pus-cells. ('Med. Times,' March 11, 1871.)

The investigations of M. Schultze have proved that pus when seen in a moist chamber and on a warm stage exhibits very beautifully the amœboid movements; whilst those of Recklinghausen seem to indicate that the globular appearance of the pus-cell is indicative of the death of the cell.

ABSCESS.

Whatever may be the origin of pus, whether degenerated lymph, or a new cell growth the result of inflammation of areolar tissue, or escaped white blood-corpuscles, a *circumscribed* collection of pus in any tissue is called an "*abscess;*" and when pus is not circumscribed but *infiltrates* a part, *diffused suppuration* is said to exist, this latter condition always indicating want of power.

An abscess that forms rapidly and is associated with severe inflammatory symptoms is known as an "*acute abscess;*" that which is the result of a chronic action and of slow formation, as "*chronic or cold abscess.*" There are, moreover, many intermediate forms.

Pus may, however, be absorbed, the serous fluid in which the cells float being taken up, and the cells left to wither—these subsequently forming a pultaceous, and, at a later date, a cretaceous mass. Clinically, however, pus may disappear altogether, and leave no external evidence of its former existence. The fact is now clearly recognized by surgeons; and the absorption of pus is constantly seen in the eye in hypopyon as well as in the disappearance of periosteal enlargements, and chronic subcutaneous abscesses.

Pus varies much in its character; when thick and creamy, it is known as healthy or *laudable* pus; when thin and watery, and containing ill-formed pus-cells, it is called "puriform fluid," this condition being generally indicative of want of power; when it is blood-stained it is called "sanious;" when thin and acrid "ichorous;" and when it contains flakes of curdy lymph "curdy." Pus from the interior of a bone is oily, containing, as Bransby Cooper showed, granular phosphate of lime. Sir D. Gibb has collected sufficient evidence to prove that the presence of cyanuret of iron may give to pus a bluish tint, while that from the brain is often green, from the liver brown; the *débris* of broken-down tissue in different proportions and of different kinds giving these appearances.

The walls of an abscess are due to the organization of the inflammatory products, whereby nature checks the extension of the disease, and forms what surgeons of old called the "pyogenic" membrane; around the walls the parts are always œdematous from serous effusion, as indicated by pitting on pressure.

An acute abscess comes on with fever and severe constitutional disturbance, accompanied by the usual local phenomena of inflammation, such as pain, redness, heat, and swelling. As the abscess forms, the local symptoms become intensified, and perhaps concentrated; the pain also alters in character, becoming at first dull and heavy, and then throbbing; the fever symptoms also subside, or rather intermit, a shivering fit or rigor more or less well marked, followed by heat, and possibly sweating, taking its place. The swelling, moreover, which was previously diffused becomes more localized; the parts covering it begin to thin, and with the fingers of one hand steadily kept flat upon the swelling, and those of the other made to press upon it in another part, the walls of the abscess will be made to bulge against the fixed fingers, and a sense of "fluctuation" be given—this feeling of fluctuation indicates the presence of fluid, and in this particular case of pus. Under these circumstances the "pointing" of the abscess will soon take place, and if the case be left to nature, the thinning of the part covering in the abscess will continue in the direction of least resistance; the skin when involved will either slough, or ulcerate, and the abscess burst, discharging its contents. The pus having now been evacuated, the walls of the abscess by their natural elasticity will fall together or collapse, the external wound close, and the whole heal or contract into a *sinus* or narrow canal, sometimes called a *fistula*. When, however, the pus is *deep-seated*, bound down by fascia or periosteum, what is called "*burrowing*" takes place; the matter makes it way between the soft parts, where the least resistance is met with, and opens either into a mucous passage, serous cavity, or joint. Abscesses beneath the periosteum constantly open into joints those beneath the abdominal muscles or within the abdomen, into the intestinal canal; and others in the extremities may burrow beneath the muscles, and make their way to the surface a long way from the original seat of the disease. In disease of the dorsal vertebræ an abscess may burrow beneath the abdominal fascia, and extend behind the sheath of the psoas muscle, Poupart's ligament, and deep fascia of the thigh, and open on the inside or outside of the thigh; whilst in other cases it may pass into the pelvis, and out again at the sciatic notch; and appear in the buttock as a "gluteal abscess." In disease of the lumbar vertebræ an abscess may also form, burrow between the abdominal muscles and appear in front of the abdomen above Poupart's ligament. An abscess beneath the scalp may undermine the whole scalp tissue; one behind the fascia and muscles of the pharynx may spread so as to cause a large post-pharyngeal tumor, and cause death by suffocation; while deep-seated abscesses of the neck may burrow into the thorax, and thus produce fatal mischief. These instances serve to show how pus, when confined beneath a strong membrane, will burrow along the cellular tissue of a part to find some outlet, and how necessary it is for the surgeon to be aware of the fact, in order that he may stop the process, or trace the cause of the disease to its source.

Acute abscess in bone is attended with severe local symptoms and constitutional distress, but to this subject attention will be drawn in a later page (chap. xxxiii).

Some *chronic abscesses* are of remarkably slow formation and give rise to very little constitutional disturbance or local distress; indeed, except mechanically, they seem to be of little annoyance unless they are secondary to some organic disease. Even then it is astonishing to what a size a chronic abscess will sometimes attain before it is discovered or complained of. In spinal cases this is often verified. In children, also, large abscesses form in the same quiet way. They are, however, never met with in the robust and strong. Abscesses connected with enlarged glands are peculiarly passive in their progress, and appear to cause pain only when they begin to make their way through the skin. Those, again, which appear during the convalescing period of joint disease when the disease seems to be undergoing recovery, show themselves in the same quiet way. They seem to be a simple breaking-down of old inflammatory products poured out in the cellular tissue during the more active period of the disease, and which has failed to be re-absorbed or to become organized. Constantly they undergo absorption, and should not rashly be interfered with.

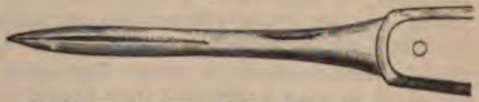
TREATMENT.—During the formation of an abscess, fomentations, poultices, and warm-water dressings give comfort, and may be used. They are only admissible, however, when suppuration and external discharge may be expected. When absorption is probable, such means should not be employed. The result, however, can only be expected in chronic abscesses which are not connected with deep-seated mischief. The local affection requires, therefore, no other treatment than rest and an absence of all irritating applications; tonic treatment and regimen being the chief means upon which reliance can be placed.

On some occasions I have drawn off the pus from a chronic abscess with the aspirator, and no re-collection has taken place, but as often as not the fluid re-accumulated, and a free incision was subsequently necessary. Whenever an abscess is opened the incision should be free enough to admit of a ready outlet of its contents, and to prevent any re-accumulation.

Wherever burrowing suppuration in a part can be detected, the sooner an external outlet is made the better, whether that burrowing be beneath the scalp, behind the pharynx, among the deep cervical tissues, in the thecæ of tendons, between the layers of muscles of an extremity, or beneath the periosteum of bones—specially about joints or anywhere beneath the deep fascia, and particularly the fasciæ of the perineum and anus.

Superficial abscesses ought always to be opened, and a lancet, or a fine double-edged knife with a central groove, should be employed (fig. 3). On the neck and face the line of incision should be made to correspond with the course of the superficial skin muscles, or the lines or folds of the part—the deformity resulting from the cicatrix being thereby greatly diminished; but in other cases the incision must be in the best direction for emptying the cavity. In all abscesses the puncture should be made where the abscess is "pointing," or the integment is thinnest; and, where this indication is absent, at the most dependent part of the abscess. The operator should always avoid dividing superficial veins and nerves, the position of the former being made out by intercepting the flow of blood through them by the pressure of

FIG. 3.



Double-edged Abscess Knife, with groove in centre.

the finger. Deep vessels and nerves should be carefully avoided, their anatomical position being always remembered. When abscesses have to be opened in their neighborhood, the incision should be made parallel to them.

In opening an abscess a plunge ought not to be made. The operator should mark the point of intended puncture with his eye, then introducing his instrument with decision through the soft parts into the cavity, make the incision of the required length by cutting outwards as soon as pus oozes upwards by the sides of the instrument. To do this sleepily is to give unnecessary pain, whereas to do it with a stab or plunge only causes unnecessary alarm. It should be done, as ought every other act of surgery, with confidence and decision; boldness and rapidity of action being governed by caution, and made subservient to safety.

To open an abscess that is pointing (or which has a cavity to be felt) by dissecting down upon it, is a *bad* practice; although in deep-seated abscesses, which are covered by parts which it would be dangerous to wound, where surgical interference is called for such a method may be the best—extreme caution being requisite under extreme danger. Under these circumstances the surgeon should follow Mr. Hilton's method of opening deep-seated abscesses, which has been practised at Guy's for many years.

In deep-seated abscesses in the axilla, says Hilton ('Lectures on Rest,' 1863), "I cut with a lancet through the skin and cellular tissue of the axilla, about half or three quarters of an inch behind the axillary edge of the great pectoral muscle. At this point we can meet with no bloodvessels. Then I push a grooved probe, or grooved director, upwards into the swelling in the axilla: and, if you watch the groove, a little opaque serum or pus will show itself. Take a blunt (not a sharp) instrument, such as a pair of dressing forceps, and run the closed blades along the groove in the probe or director into the swelling. Now, opening the handles, you at the same time open the blades, situated within the abscess, and so tear open the abscess. Lastly, by keeping open the blades of the forceps during the withdrawal of the instrument, you leave a lacerated tract or canal communicating with the collection of pus, which will not readily unite, and will permit the easy exit of matter." In this way deep cervical and post-pharyngeal abscesses, deep abscesses of the thigh, leg and forearm, may be fearlessly opened.

When an abscess has been opened it should be left to discharge by itself, a simple poultice or warm-water dressing being applied over the surface. Any squeezing or pressing upon the walls of the abscess is unnecessary and injurious. In some, it is well for a few hours to introduce a piece of oiled lint between the edges of the wound to prevent its closure, more particularly when the deep fascia has been opened; whilst in others of large size, the introduction of "a drainage tube" made of a piece of India-rubber tubing perforated at intervals may be required.

Tonics and good feeding are always essential elements in the treatment, sedatives being given only when required.

In acute inflammation about the hand or foot an opening cannot be made too early; indeed, it should be made as soon as effusion has taken place, and the soft parts are tense. Under these circumstances an early incision by relieving tension will often save tissue, and the operator must not think that he has done wrong when, on making the incision, he finds no pus exudes.

When a *chronic abscess* requires opening—a question which in every case should be well considered—a free incision should be made into its cavity, its contents evacuated, and the cavity well washed. For this latter purpose nothing has answered so well in my experience as a mixture of one or two drachms of the tincture of iodine to each pint of tepid water; a drainage tube should then be introduced, care being taken that if air enters, its exit also can be guaranteed. The abscess should be washed out daily.

Mr. Lister's plan of covering the opening with a piece of lint soaked in carbolic oil, to prevent the possible admission of air or any septic matter, seems good, whatever may be the theory of its action. I have treated by these means an obscure case of abscess, in a young lady, æt. 18, of the left loin and abdomen, spreading as far as the median line, and showing itself below Poupart's ligament. Quarts of pus were evacuated, and the whole closed within a month, or rather degenerated into a small sinus which discharged serum for three or four weeks and then healed without the slightest constitutional disturbance. I have treated likewise a spinal psoas abscess, and others of the thigh and loin, with equal success; while another, clearly renal in its origin, might be recorded to support the practice.

The practice consists in making a free opening into the abscess, and then applying over it a piece of lint soaked in carbolic oil (one part of acid to twenty of olive oil), beneath which the pus flows away; in this manner no air is admitted. In the subsequent dressings care must be taken to keep the opening surrounded with the vapor of the acid, and the lint should only be removed and be replaced by a freshly steeped piece. No pressure should be made upon the walls of the abscess for the purpose of emptying its cavity without the opening being covered with carbolic oil. I have, however, used, in several cases, olive oil alone with equally good results. With the similar object of excluding air and its impurities, the use of the trocar and canula have been suggested, a valvular skin opening being secured by drawing the integument to one side before making the puncture. The trocar invented by Mr. Thompson, of Westerham, is also good. In it an elastic tube is fitted to a second mouth below the instrument. But beyond any of these in their usefulness, when such a practice is demanded, Dr. G. Dieulafoy's "aspirator" is to be preferred; for by it the contents of any cavity can readily be *explored* or withdrawn, without the possibility of the entrance of air.

Suppurating ovarian and hydatid cysts may be treated as large abscesses, and with considerable success. Empyemata or abscesses in the chest can also be dealt with on the same principle, by a free opening into the thorax and a free outlet for the pus. In these cases the drainage tube is of great value, care being necessary to drop one end of it well down to the bottom of the cavity.

The drainage tube was suggested by M. Chassaignac, and is simply a small india-rubber tube, perforated every inch or so with holes to allow of the free escape of the pus. When large cavities are opened they should be washed out, at intervals, with an iodine lotion or Condy's fluid, so that nothing like decomposition, as indicated by fetor, may be allowed. With this precaution large suppurating cavities can be dealt with successfully.

When veins and large arteries are opened, by ulceration, into abscesses—an accident of occasional occurrence—they should be treated on the principle laid down in the chapter on hemorrhage, *i. e.*, if the bleeding vessel be large, it should be secured at the point at which it has given way, either by ligature or torsion; and if small, the hemorrhage can easily be arrested by pressure.

Chronic abscesses associated with glandular enlargement need not be opened under some circumstances, because with constitutional treatment they often disappear; yet they should be so treated as soon as it is clear that they will open by natural processes, if let alone, in order to save the ugly cicatrix that takes place under these circumstances from ulceration of the skin. The surgeon should make a small puncture in the best line to allow of the exit of the pus and to prevent disfigurement. Gentle pressure with cotton wool over the part afterwards, often hastens the recovery. In subjects of the hemorrhagic diathesis an abscess may be opened by the cautery or canula.

Arrest of Acute Inflammation by the Obstruction of the Main Artery of the part.

To arrest acute inflammation in a limb, the deligation of the main artery of the limb, or the arrest of the circulation through it by pressure upon the artery, has been adopted. Dr. Campbell, of New Orleans, speaks highly of the practice, and even affirms that no portion of an extremity should be amputated for destructive inflammation without this experiment being attempted. On the suggestion of Mr. Maunder, of the London Hospital, Mr. Little, in 1867, applied a ligature to the femoral artery for acute suppuration of the knee, with a success sufficient to prove the value of the practice. Mr. Maunder, too, has since successfully had a similar result ("Lettsom. Lect.," 'Lancet,' 1875). The late Mr. Moore, of the Middlesex Hospital, also acupressed the brachial artery with a good result. Previous to these cases, however, as early as 1813, Dr. Onderdonk, of America, ligatured the femoral in a case of wound of the knee-joint, to check acute inflammation, and others since his time have followed his practice. It is a method of treatment certainly worthy of attention, inasmuch as to cut off the supply of blood to an inflamed part, when too much is passing to it, is sound in theory; and to do the same to starve out the disease is equally scientific. In elephantiasis Arabum the practice does not seem to be without its good effects, and, in acute disease, it is certainly admissible.

I well remember, as a student, observing, under the care of Mr. Bransby Cooper, a serious case of compound fracture of the leg, complicated with a severe laceration of the thigh and division of the femoral artery of the same side. He was in doubt as to the practice he ought to follow, not knowing whether with the divided femoral the supply of blood would be sufficient to repair the compound fracture. The success of the case, however, proved that the fear was groundless, for repair went on uninterruptedly, and a good limb was the result. The patient was a man of middle age. In 1873 I also treated with uninterrupted success a case of compound fracture of the humerus into the elbow-joint in a man where the brachial artery was obstructed, recovery with a movable joint being accomplished.

With respect to the treatment of inflammation by the *digital* compression of the main arterial trunks leading to the injured or diseased parts, it must be recorded that in 1861 Dr. T. Vanzetti, of Padua, wrote a paper upon the subject, which Mr. S. Gamgee has translated in his work 'On Fractures' (1871). He was led to apply this treatment to cases of inflammatory disease from its success in the treatment of aneurisms. He asserts that compression will cure every incipient inflammation, and check it even when advanced, and he adduces cases of phlegmonous erysipelas and acute arthritis of the hand successfully treated by such a process. He adds, however, that "in the treatment of aneurisms as of inflammations, compression can never become a normal method until it be always and exclusively effected with the finger."

SINUS AND FISTULA.

A fistula is an unnatural communication between a normal cavity or canal and the outside of the body or second cavity or canal.

A sinus is a narrow suppurating tract with only one orifice.

Both will now be considered. Thus, amongst the *fistulæ*, there are the vesico-vaginal and the recto-vaginal fistulæ in women; the recto-vesical in men; fecal fistula, gastric and biliary fistulæ, anal fistula, salivary fistula, and urinary fistula. They are always due primarily to some suppurative or ulcerative process, or mechanical violence, operative or otherwise, and subsequently, to a want of repair. When passages are close together, the fistula will be short and direct; in some large, in others narrow or tortuous. When the cavity or canal is deeply placed, or the inner opening deeply situated, the fistula may be a long narrow tract. When the fistula is of *recent* origin and lined with granulations discharging pus, the walls will be soft, readily bleeding on manipulation. When *old*, they will be smooth and hard, "callous" all over, and non-sensitive, secreting a thin, watery, non-purulent fluid. This fluid is, moreover, mixed with the contents of the cavity or tract with which the fistula communicates, the discharge tending to keep the fistula open.

The *external* opening of a fistula or sinus presents very different appearances. It may appear as a direct or as a valvular opening, depressed, or raised. When leading down to a foreign body or to bone, the external orifice will be surrounded by weak granulations. Sometimes it may scab over for a time, and then reopen by the force of the retained fluid.

The *internal* opening of a fistula mostly appears as a defined orifice.

Of *sinuses* or incomplete fistulæ, abscess is the most common cause; the external communication failing to close from some defect in the healing power of the part; from some interference with the reparative process; from the constant discharge of pus, which has not a sufficiently free vent; from muscular action, which forbids that amount of rest of the part which is required for its repair; or, lastly, from the presence of some foreign body introduced from without, from dead bone or cretaceous inflammatory product from within.

The TREATMENT of the different forms of fistulæ is given in the chapters devoted to the special organs that are involved. In a general way, however, it may be asserted that so long as the cause of the fistula exists, repair cannot go on; so that, in urinary fistula, when stricture is the cause, the stricture must be treated before the fistula. In anal fistula, when the action of the sphincter ani forbids repair, its action must be paralyzed. In fecal fistula, when obstruction to the bowel is present, the obstruction must be removed. In salivary fistula, the salivary duct must find a natural outlet before its unnatural orifice can be expected to close. When any foreign body, tooth or dead bone, is keeping the sinus open, it must be removed. When a suppurating cavity at one end of the fistula continues to discharge, means must be taken to close it. When these objects have been achieved attention may be directed to the fistula or sinus itself, and various are the means that can be employed for their cure.

Pressure in *recent* sinuses, to keep the parts in apposition, by means of pads, strapping, or bandages, is sometimes of use, the muscles that move the part being kept absolutely at rest thereby. In stumps, and after mammary abscesses, this practice is very beneficial.

Injection of some stimulating fluid, such as the preparations of iodine (either the tincture alone or diluted with one or two parts of water) will sometimes set up a healthy action; for the same purpose a *seton* has been used, and of all setons the small *drainage tube* is the best, or a narrow coil of rolled gutta-percha skin. The *cautery* is sometimes of great use, and the galvanic is to be preferred. It can be accurately applied to the exact spot, and its heat maintained for any required time. It is generally most useful in small fistulæ.

Laying open the sinus is, however, as a rule, the best plan, dividing it from end to end, and keeping the sides asunder to allow of its healing from below. When done with a knife the incision is to be made upon a grooved probe or director which has been previously introduced through the sinus. This, however, may often be done to great advantage with the wire of the galvanic cautery. When the cautery is used, the wire should be passed through the sinus on the grooved director, or threaded in an eyed probe; the surgeon then holding the two ends of the wire, made hot by contact with the battery, and dividing the tissues with a sawing motion. The division with the cautery has this advantage, that the surface of the sinus is so destroyed that it must granulate. There is consequently less need of careful dressing, and in old sinuses this is a point of importance, for their surfaces are so callous that they require to be scraped or otherwise rendered raw, to permit of granulations forming.

The division of a fistula with a ligature is now rarely performed, although with an india-rubber ligature it is feasible. In "bleeders" it might be called for, but in these the wire of the galvanic cautery is preferable, when it can be obtained.

Plastic operations for the cure of fistulæ are also means of great value, particularly of vaginal and rectal fistulæ. These will be discussed in a future chapter.

Last, but not least, in the treatment of sinuses and fistulæ, constitutional treatment should be employed. In the fistula following operative or suppurative action, such treatment is, as a rule, all that is wanted, and many are the cases in metropolitan hospitals of sinuses about stumps, skin wounds, or mammary wounds, that will heal rapidly under the influence of fresh air, good food, and tonic medicine. In all cases these means are most essential, and, with them and local treatment, success is generally to be attained.

ULCERS AND SORES.

Ulceration is an inflammatory process, in which a *sore* or *chasm* is produced by the molecular death of the tissue involved.

A sore is a chasm, a solution of continuity, caused by ulceration upon an external or internal surface of the body.

When a *sore* is being formed, or is spreading by the process of ulceration, an *ulcer* is said to exist; when the ulceration has ceased, a *sore* remains.

When an *ulcer* spreads rapidly it is termed *phagedænic;* when it spreads by gangrene, *sloughing;* and when with this gangrene the molecular death of the tissue, or ulceration, is combined, *sloughing phagedæna* is said to exist. All these processes are consequently different forms of different ulcers, and are characterized by degrees of rapidity of the process; the simple ulcer being the mildest, and the sloughing phagedænic the most severe form.

A healing sore heals by *granulation* and *cicatrization*, the process of healing being the same in it, as it is in any open wound the result of injury or operation. Sores may be *healthy*, *inflamed*, *weak*, *indolent*, *sloughing from excess of indolence*, or *irritable*, terms which are applied to sores to express their conditions at the time, but having no special signification, for these appearances fluctuate according to the general condition of the patient and the local treatment of the sore. A sore may also at any time take on the ulcerative process and spread, or assume any of the forms of spreading already described.

An ulcer may originate from a *local* or a *constitutional* cause.

Among the *local causes* are injuries produced by blows, pressure, or some irritating application, or some skin eruption set up or followed by inflammation and subsequent ulceration. If a piece of skin dies, it is cast off by ulceration; if a portion of integument inflames from some external irritation, a local eczema or skin eruption, an ulcer follows. An abscess may form beneath the skin or in the deep parts, and burst by ulceration. It may be that some deep-seated disease was the cause of the abscess, but the ulceration spreads and remains as an ulcer.

Amongst the *constitutional* causes, *excluding cancers*, may be classed anything that superinduces a low condition of the vital powers, such as any illness, certain habits of life, syphilis, or scurvy.

It should be remembered, however, that ulcers which have a constitutional origin may be kept up by local causes—thus, a syphilitic or cachectic ulcer originating from a general cause may take on any of the characters common to the healing ulcer or sore, in the same way that a local ulcer or sore, produced from local causes, may fail to heal from some constitutional defect.

Lupus, rodent ulcer, epithelial or carcinomatous ulcers, stand by themselves, and are called *special* ulcers.

There are also **local** sores originating from local causes, which are often kept from healing through some general or constitutional failing; **constitutional** sores originating from constitutional causes, that may fail to heal on account of some local condition interfering with repair; and **special** sores. For the treatment of such it is most essential that the three different forms be recognized.

Local sores, as already stated, have a local origin—something causing inflammation and ulceration in the skin, and a sore remaining; the disease being cutaneous from the first. The few cases connected with diseases of the deep-seated parts, such as the bones and joints, can readily be known.

Constitutional sores have rarely cutaneous origin, unless originating in some ulcerating skin eruption, such as ecthyma or rupia; but they almost always commence in the subcutaneous connective tissue as a more or less circumscribed induration, which lasts a very variable period, and then softens down; the skin over it inflaming, sloughing, and ulcerating, to give vent to a deeper slough; the sores or ulcers always being of a *cellulo-membranous kind.* These ulcers may have their cause in an ordinary cachexia or in syphilis, but the cellulo-membranous ulcer is always constitutional, and requires *general* more than *local* treatment. In syphilis the ulcers are the result of broken-down subcutaneous "gummata." The appearence of these sores will depend much upon the period at which they are seen; but, from the time when the skin has broken and ulcerated, the margins of the skin opening will appear thin, irregular, and undermined, and, at the bottom of the opening, the slough will appear. When simple, the slough will appear more or less white, sometimes pearly; but when syphilitic, it will have the aspect of a *piece of wet washleather*, at least, in the majority of cases. When any of the slough has come away the skin will at first be undermined, and the margin of the sore fall inwards, but, as the granulations rise from below, the skin will be pressed up, although when the wound has cicatrized, the scar will almost always be a depressed, and in syphilis, a stained one.

Around this sore several small openings often coexist, each one having formed to give exit to a small slough, the margins of which appear as if they had been punched out. These sores occur mostly about the lower part of the thigh and knee, elbow, shoulder, and forehead, and are found, however, in any part of the body. The syphilitic are always surrounded by a *dusky* kind of inflammatory border, and are rarely painful; the non-syphilitic with a pinker blush. The washleather slough and dusky margin clearly indicate the syphilitic sore.

It is by no means uncommon to discover in such a sore the specific character of a disease that had been contracted some twenty or more years previously, and that had lain dormant after having manifested its presence by marked symptoms. Indeed, it is from the occurrence of such sores as these that the surgeon inquires whether constitutional syphilis is really ever cured—that is, eradicated—and whether a man once syphilized, as once vaccinated, is not so permanently altered as to show under certain conditions, with comparative certainty, that he is still under the influence of the poison, and that other diseases must for ever after be modified by its existence.

Special sores will be described with the diseases from which they result.

A healthy, healing, cutaneous sore is known by the small, florid, conical granulations that cover its surface, and the healthy creamy pus thrown off. "In granulations, new substances are formed as if the earth was taken in heaps from one place and laid in another; the *thicker and smaller the heaps* the better the granulations" (John Hunter, MS. lect., 1787). The granulations are not so vascular as to bleed, or so sensitive as to cause pain on the slightest touch. The margin is natural, and where the skin and granulations meet, a band of cicatrizing tissue is to be seen, assuming, where in union with the skin, a whitish line with a fine covering of epidermis; but where in contact with the granulations a more vascular appearance than at any other point of the sore, the centre of the band being covered with a thin, purplish-blue, semi-transparent film.

By the gradual and centripetal cicatrizing process of the outer border of the band, and the gradual narrowing of its circle, the sore heals.

Treatment.—The surgeon's sole aim being to guard against anything that can interfere with the progress of repair, the treatment is simple; a piece of wet lint to absorb discharge and protect the surface of the sore from injury being all that is required, the lint being kept moist by a piece of oil silk, gutta-percha, or elastic tissue. Where water irritates, oil may be substituted. The surface of the sore should be cleansed by means of a stream of tepid water; sponges should never be used, and cotton wool is the best substitute, as it can be destroyed after use.

Where the granulations are disposed to rise too high, dry lint may be applied, and at times a good rub with lunar caustic hastens recovery. Small sores thus treated may be allowed to scab. Rest is always beneficial in aiding repair, but should this be impracticable, a good bandage may be substituted, and a piece of thin sheet-lead bound over the sore outside the dressing will give efficient support. In removing the dressing, care should be taken not to injure the band of delicate cicatrizing tissue.

Accepting this description as that of a healing sore, deviations from this type constitute the different forms that have been described. Thus, when the granulations assume a large, pale, elevated, watery appearance, the sore is said to be *weak*, the granulations in popular language being "proud flesh," the popular word "*proud*" being synonymous with *weak*. There is power in the sore to granulate, but the granulations have little power of cicatrizing, they are disposed, moreover, to slough on the slightest cause. These require local stimulants, such as the nitrate of silver in stick, sulphate of zinc or copper lotion, carbolic acid lotion in the proportion of two grains to the ounce, or terebene alone or diluted with one or two parts of olive oil. Dusting the surface with powdered alum or tannin is also sometimes beneficial.

The limb should be carefully elevated or bandaged, and the general health attended to.

When there is still less power in the sore no granulations form, the surface puts on the appearance of a piece of mucous membrane, such as that of the pharynx, the sore being then called *indolent*. At times a few weak granulations are found at one corner of its surface, but the greater part has a smooth and glassy aspect, with a thin and watery, but not purulent secretion. Where the sore has existed long the edges will appear raised and indolent, covered with a layer of epithelium, and very senseless. It then acquires the term "*callous*"—a callous sore being an indolent one of long standing. This indolent sore is always ready to take on a sloughing action on any slight cause, such as some general derangement of the health, or the long assumption of the dependent position of the limb. It is common, indeed, to find the surface of the indolent sore *sloughing;* not, however, from inflammatory action, but from *extreme indolence in the granulating force.* Under these circumstances the surface of the sore becomes covered with a greenish secretion often fetid, the granulations forming partially, and ultimately dying. When the sore is large, this appearance is very commonly towards its centre, or lowest part; and as repair goes on, the sore may cicatrize at its edges, where the granulations derive the full benefit of the vascular and nerve supply, while the centre of the sore still sloughs. In old people the margin of the sore may slough in one part and heal in another. Authors have described this indolent sore in the old as *senile ulcer*. These sores are very common and are usually found in the lower extremities, often, too, associated with varicose veins; this condition of veins has, however, little to do with their origin, although it tends much to retard their recovery. These have been described by old authors as *varicose ulcers*, simply from the fact of the two conditions being often found together. Such are almost always found in weak subjects, with a feeble circulation.

The treatment of these indolent sores consists in encouraging the venous circulation of the part by position if possible, and by pressure where rest cannot be secured; by local stimulants, and by general tonic treatment. When there is little or no action in the sore, the application of one or more blisters to the surface is very beneficial; or blistering liquid may be painted over its edges. When the surface is sloughing, half an ounce of carbolic acid or of terebene to a pint of olive oil with or without the extract of opium, according to the amount of pain, is an excellent application. Where the edges of the sore are indurated and callous, so that cicatrization and contraction are almost impossible, the free scarification of the margin every half inch is often followed by a rapid change for the better; or two free incisions may be made on either side of the margin of the sore for the same purpose. During this treatment, if the venous circulation is assisted by raising the leg higher than the hip, the utmost good may be obtained. When rest cannot be observed the limb may be strapped up from the toes to the knee—omitting the sore—firm pressure being applied by means of a piece of sheet-lead and a bandage over the dressings. In private practice, when the leg can be dressed daily, the whole limb may be covered with the strapping. The strapping, therefore ought to be good, not such thin material as that spread on calico, nor thick, felt strapping, but that spread on linen, such as is sold by Leslie, or Messrs. Gerrard & Co., and used at Guy's Hospital.

When the sore is painful, or the patient has an irritable pulse, the beneficial effects of opium twice a day in a pill are very marked; and quinine, iron, nux vomica, or the vegetable bitters, may be given, as the wants of the case indicate. The bowels also require attention, drachm doses of the sulphate of magnesia, with quinine, being a good aperient. When the sore is unusually large, and there is little probability of the whole healing from loss of skin, fresh centres of *cutification* should be inserted by transplantation. In this way I have brought about the cicatrization of a large sore of twenty-four years' standing in three weeks, and many others of smaller size in an equally short period; indeed, by this practice of skin-grafting, I believe the necessity of amputation in the more severe forms of this affection will be greatly diminished; for hitherto indolent ulcers that surround a limb have ever proved themselves incurable, amputation being their only remedy.

All sores may inflame or become irritable, but there is an *inflamed sore* or *ulcer* which is found in subjects with thin and fair skins who are in some way reduced in power, or "out of sorts," either from irregular living, over-work, or bad feeding. It appears as a small superficial, inflamed, irritable sore, with a raw-looking appearance, an ash-colored slough, or thick secretion over its surface, and discharges a thin, ichorous fluid, sometimes tinged with blood. The patient will complain of its excessive painfulness, particularly at night, and will dread its being touched. It will look red and angry, though superficial. A blow or a graze may have caused it, or a local patch of eczematous inflammation, in which case it may be described as an *eczematous ulcer*.

The *treatment* of these sores is very troublesome, the skin being usually highly sensitive. They always want soothing, and the best lotion is one of lead mixed with extract of opium, but this sometimes irritates, while the lead or zinc ointment gives comfort. At other times a cold bread poultice is the best application. In all cases the limb wants rest and elevation; plasters rarely being tolerated. In the eczematous sore, where the discharge from the eruption round the sore is profuse, the powdered oxide of zinc and starch, in equal proportions, may be used; or, the surface may be washed with a solution of nitrate of silver in the proportion of ten grains to the ounce. Occasionally a solution of the extract of opium is the best lotion. Simple nutritious food, with a moderate allowance of stimulants, should be administered, but all high feeding is injurious. The general health mostly requiring tonics of a non-stimulating kind, such as the vegetable bitters with alkalies, as the intestines are generally irritable. When the pain is severe, opiates and sedatives are indicated. In very inflamed sores the application of a few leeches occasionally gives relief at some distance from it. These sores are invariably obstinate.

Authors describe a *varicose ulcer*, but it is questionable whether such exists. Many indolent sores are doubtless associated with varicose veins, and are probably indolent on account of this association; but how far they are really caused by them is a different matter, for varicose veins and ulcers of all kinds are constantly met with together. Of all ulcers entitled to the term varicose, the eczematous has probably the most claim, for certainly eczema of the leg is a common consequence of varicose veins, and an ulcer the result of the eczema.

Practically, however, it is well to remember, that when varicose veins exist *with* an ulcer, repair cannot go on favorably unless the venous circulation of the limb be assisted by position or pressure; and that where these varicose veins are present, all ulcers or sores are disposed to become indolent if neglected. When an ulcer takes its origin from an inflamed vein the term is applicable, in a measure, but this ulcer has no special characteristics.

Sores that are prevented from healing by varicose veins must be treated by the elevated position of the limb, by bandaging or strapping, and, in bad cases, by the obliteration of the veins. Without this obliteration the treatment will, of necessity, fail; whereas with it the sore may be expected to heal with the use of such general and local means as its nature may require.

How far it is right to heal an old chronic sore has not yet been quite decided. Older surgeons declared it to be inexpedient, as cases were met with in which apoplexy or some other alarming condition supervened. Modern surgeons, however, are disposed to question the explanation of these facts, and to look upon that practice as beneficial which removes any abnormal condition, local or general. Still, it is wise, when a patient has been in the habit of losing by discharge from the surface of a sore, a certain amount of material which would otherwise have been used to maintain the general powers, to cut off the supplies in another way, to order more abstemious living, and to regulate the bowels by some saline water, natural or artificial, as may suit the stomach.

Sloughing and phagedænic sores are rarely seen, except in connection with syphilis or hospital gangrene. In syphilis, sloughing is found in the intemperate and ill-fed, and mostly in gin-drinking prostitutes. It attacks any surface that has been made sore, either from venereal contact or other causes; and it is marked by the rapid way in which the process destroys tissues, by the fetid character of the discharge, the great depression of power as an invariable accompaniment, and the constitutional disturbance.

Opium in full doses is required for their TREATMENT, with tonics and good nutritious food. When this does not control the ulceration, the application of strong nitric acid with a piece of wood to the surface of the sore is often useful: sometimes, too, the local application of iodine or bromine in solution is of great benefit. Fresh air is always indicated, and abundance of disinfectants, such as Condy's fluid, or carbolic acid in some of its forms. These sores are mostly due to some feeble constitutional condition, and not to a local cause, although at times the local action seems to continue by itself, requiring some powerful escharotic, such as nitric acid, to check its course.

Sir J. Paget describes *cold ulcers*:—"They are like small inflammatory ulcers, occurring spontaneously in the extremities, especially at the ends of the fingers or toes, or at the roots of the nails. In some cases they are preceded by severe pain and small gangrenous spots. They are, in many respects, like ulcerated chilblains, but they occur without any exposure to intense cold in patients whose feet and hands are commonly, or even habitually, but little warmer than the atmosphere they live in. Such patients are among those who say they are never warm, and the skin of their extremities, unless artificially heated, is to the touch like the surface of a cold-blooded animal. With this defect, which is common in women, there is a small feeble pulse, a dull or half livid tint in the parts which in healthy people are ruddy, a weak digestion, constipated bowels, and scanty menstruation.

"The cure of the ulcers and prevention of their recurrence lie in the remedy of these defects. Many tonic medicines may be useful, but the most so is iron; with it purgatives are generally necessary, *e. g.*, small doses of mercury and aloes or of sulphate of magnesia. Full diet also is required, exercise in the fresh air, very warm clothing, especially of the lower half of the body, and warm bathing; dry applications, or lotion of sulphate of zinc or copper, are the best local means, and the part must be kept warm; healing is always tardy at a low temperature."

Allied to cold ulcers are those formed on fingers or other parts which have been deprived of their nerve supply by some injury.

Scorbutic Ulcer.—In Sir J. Paget's able article in 'Holmes's System' occurs the following description of the scorbutic ulcer by Mr. Busk:—"Although scurvy in itself cannot be said to be attended with any peculiar form of ulceration, ulcers or sores of any kind already existing from other causes assume, in consequence of this scorbutic taint, a more or less peculiar character, and, when thus modified, have been usually termed 'scorbutic ulcers.'

"Scurvy essentially consists in an alteration in the constitution of the blood, which leads to the effusion into the various tissues of a *fibrinous exudation*, usually deeply colored, and which has on that account been commonly regarded as a simple coagulum. That this effusion, however, can scarcely be regarded in this light, is proved by several considerations, but more especially by the circumstance that it is from the first *solid* and *capable of becoming imperfectly* organized; that is to say, it is after a time permeated by newly-formed vascular channels. It is the presence of this effusion which causes the spongy swelling of the gums, the tumefaction and induration of the intermuscular tissue, the so-termed *scorbutic nodes*, and which, when poured out on the surface, or in the substance of the corium, constitutes the vibices and petechiæ so characteristic of the disease. It is the *effusion also of the same semi-plastic material on the free surface of sores or ulcers which gives them the peculiar aspect termed scorbutic.*"

"Ulcers of this kind are distinguished by their livid color and irregular tumid border, around which no trace of cicatrization is evident, whilst the surface of the sore is covered with a spongy dark-colored, strongly adherent, fetid crust, whose removal is attended with free bleeding, and is followed by a rapid reproduction of the same material. This crust, in bad cases, as remarked by Lind, attains to a 'monstrous size,' and constitutes what has been appropriately termed by sailors 'bullock's liver.'"

The Syphilitic Superficial Sore.—The deep cellulo-membranous syphilitic sore has been already described (page 36), under the heading of constitutional sores, but the *superficial, cutaneous, rupial syphilitic* sore deserves notice, because it is very common. It mostly succeeds an ecthyma or rupia, is mixed with the eruption in some other stages, and is simply an ulceration of the base of a syphilitic eruption. This goes on increasing irregularly in a serpiginous form, the sore healing in one place and spreading in another; but it involves only the skin. The edges of the sore, or sores—for they are often numerous—are usually well defined, and frequently irregular; the surface too is generally of a deep color; and, when healing, may either scab or granulate, as any other sore. They are met with at any period after the first constitutional symptoms of syphilis have passed away, and occasionally at a remote date; they are always found in a cachectic or enfeebled subject; indeed, it appears as if want of power allowed the disease to manifest itself in the new form.

The treatment of these sores, when once recognized, is not usually difficult. Tonics, with the iodide of potassium or sodium, in doses of from three to ten grains, usually effect a cure, at least for a time; liquor cinchonæ and compound spirit of ammonia in half-drachm doses are also good remedies. In other cases quinine or iron is indicated. Mercurial remedies are sometimes, though rarely, necessary; perchloride of mercury, in doses of $\frac{1}{16}$th of a grain in bark, green iodide in one-grain doses in a pill, or the mercurial suppository, being the best forms to employ.

Locally, the sores may be dressed with any simple dressing, but when indolent, a mercurial lotion, as the black wash, is the best.

Lupus must be classed amongst the ulcers. It is met with in two forms—the *lupus erythematosus* and the *lupus vulgaris*—the latter being more common in young scrofulous subjects, and the former in the middle-aged. When associated with a spreading ulceration, it has been called *lupus exedens.*

The "lupus erythematosus" occurs chiefly upon the face, and is symmetrical; each patch has well-defined edges, and a red, scaly surface, with small horny points upon it, due to accumulation in the dilated mouths of sebaceous ducts.

The "lupus vulgaris" has its origin in a skin tubercle, or tubercles, of a flat form, fleshy consistence, and pink shining appearance, and these at times ulcerate. This lupus ulceration, when once originated, progresses steadily, destroying every tissue it attacks, and when it reaches the nose—its very favorite seat—it simulates cancer. The surface of the sore is sometimes free from all signs of granulations, and often very irregular, while the edges are ragged, raised, and often everted. It is painless. The tubercles themselves feel spongy, are not so hard as cancer, nor so well defined.

These lupus ulcers are more commonly found on the face than elsewhere, and probably next in frequency, on the female genitals. They are most destructive when left alone, but often very amenable to treatment. In young adult life they are more common than in the old, and appear closely allied to tuberculosis.

TREATMENT.—Although the disease has probably a constitutional origin, and requires tonic treatment, both by medicine and regimen, there is no disease that derives more benefit from local treatment. When the ulceration is superficial, and the skin is not deeply infiltrated, the local application of cod-liver oil on lint, and the covering up of the part with cotton wool to keep it warm, has at times worked wonders. But under other circumstances, when the skin is deeply involved and infiltrated with disease, the free destruction of the whole growth is the best treatment, and this may be effected by scraping the surface of the growth, by caustics or cautery. Since employing the galvanic cautery as a local caustic, I have burned down many of these lupus ulcers, and even tubercles, and been surprised to find how rapidly a healthy cicatrix forms. Paquelin's thermo-cautery seems, also, of equal value.

Where this treatment is inapplicable, the destruction of the surface by some escharotic should be undertaken, the chloride of zinc paste being probably the most effective. But whether the galvanic, or thermo cautery, or escharotics, be used, it is essential that the whole tissue be destroyed down as far as the healthy structures. In some cases I have scraped or broken down the growth with the handle of a knife, or even cut off the margins, and then applied the cautery to the base of the sore. The same practice may be followed when caustics are applied. In exceptional examples excision is beneficial, the sore being left to heal.

Rodent and cancerous ulcers will be treated under the head of tumors.

BED-SORES.

In theory bed-sores should never occur; yet in practice they appear in certain cases, in spite of the greatest care and attention. It is well, however, for the surgeon to act upon the theory, as by so doing he is stimulated to do everything in his power to guard against their occurrence, and no better illustration of the old adage, "Prevention is better than cure," could be found than in such a case.

Bed-sores may briefly be described as the death of a part from mechanical pressure, the parts involved in some cases literally dying from being deprived of their nourishment by prolonged and continued pressure; in others from some inflammatory action induced by it.

Bed-sores may arise in healthy subjects who are kept unmoved for ten or fourteen days; but in the old, the fat, or very thin, they may occur at an earlier date, as they do in fever cases of all kinds, and in spinal or partially paralytic cases; completely paralyzed parts are less prone to slough than the partially paralyzed.

Dirt and moisture under all circumstances accelerate their appearance.

A bed-sore may appear as a simple abrasion, a sloughing of the skin, or subcutaneous tissue, and in severer cases the exposed bone may die, and in the worst the spinal cord may be opened.

TREATMENT.—Since, as a rule, they are caused by continual pressure on a part, they may very generally be averted by some change of the patient's position. The necessary amount of movement may, as a rule, be allowed in all medical and in most surgical cases, but local pressure under all circumstances should be periodically relieved.

The skin of the part pressed upon should be hardened by washing it, at least twice in the twenty-four hours, with some camphor spirit and water, vinegar and water, or nitrous ether and water, in the proportion of one part to three. An artificial covering of the flexible collodion is occasionally of great use.

When the parts are about to slough, these applications, however, are useless, and nothing but the removal of pressure will suffice. With this object, well-filled water beds and water or air cushions should be employed. I have found a mattress divided transversely into three parts and a water cushion substituted for the middle section of great use. At other times the sections of the mattress may be simply separated for a few inches in the line of pressure.

In spare patients, where the spinous processes of the vertebræ are prominent, thin strips of felt plaster placed vertically down the back give great relief, and the same plaster applied to other painful parts is of value; cushions of amadou and well-adjusted pads of cotton wool or spongio-piline are also always of service.

When sloughing is present, a linseed-and-bread poultice with a solution of carbolic acid, of iodine, Condy's fluid or charcoal sprinkled upon the surface is the best application, though a carrot or yeast poultice occasionally cleans the wound.

When the slough has separated, some stimulating lotion or ointment may be required; this is best applied on cotton wool.

In all cases where patients have to rest for a lengthened period, careful attention should be paid to keep the bed smooth, and the sheets free from rucks. Corded or feather beds should not be used. The best is a horse-hair mattress placed upon a second or spring bed.

MORTIFICATION, TRAUMATIC, ARTERIAL, AND VENOUS.

The mortification of any part of the body signifies its death. When a soft part is "dying," it is said to be in a state of "gangrene;" and when "dead," in that of "sphacelus." The dead portion is called a "slough," and the process of separation the act of "sloughing." When bone is dead, the term "necrosis" is employed; the dead portion being called the "sequestrum," and the process of its separation "exfoliation."

The dead portion of any tissue is thrown off from the living by means of ulceration; and when the slough has separated, the parts heal by granulation, as an ordinary wound. In the "sloughing phagedæna" the two processes of ulceration and sloughing are combined, the molecular death of a part, or ulceration, going on with the more general destruction of gangrene.

Direct violence, mechanical or chemical, may be the cause of mortification, either by destroying the vitality of a part at once, or by exciting inflammation in it which induces its death, such cases being called "traumatic." In this group a large proportion of the cases of gangrene are found.

In the second group are found those in which a part is starved, the main artery of a limb being obstructed, either from operation, accident, or disease—this may be called anæmic gangrene.

In the third group may be classed all those cases in which the stagnation of blood is caused by the mechanical arrest of the circulation through the veins, complicated or not, with secondary inflammatory action. This form is called "static gangrene."

In each and all of these, inflammation plays directly or indirectly, an important part.

Tissues suffering from defective nutrition, either as the result of some want of nerve supply or energy, or of extreme debility the consequence of severe illness, or other depressing influence, are more prone than others to mortify on slight causes.

When mortification takes place in tissues that are filled with blood, and more particularly with inflammatory fluids, "moist, hot, or humid gangrene" is produced; but when it takes place in parts in which no such stasis exists, and where death of the tissues is the result of a want of arterial supply, "dry, cold, or chronic gangrene" is caused.

These two forms, however, are in a measure convertible—the rapidity of the process and the amount of inflammatory infiltration influencing the result.

Direct traumatic gangrene is well seen in the destruction of skin from the contact of some corrosive acid, such as sulphuric or nitric acid; the black or yellow slough which immediately follows the application of the caustic testifying to its action.

Indirect traumatic gangrene is also well seen in the integument after the application of a blister to a child or feeble patient, the blister being followed by inflammation of the blistered part, and its subsequent death.

In bad compound fractures the indirect inflammatory gangrene is often illustrated, the limb swelling rapidly, and the skin assuming a mottled and livid hue; loose blisters or phlyctenæ of raised cuticle soon forming on the surface, containing more or less blood-stained serum, while the tissues become sooner or later cold and insensible, the temperature of the part often falling rapidly. The fluids from the wound, when any are present, soon become offensive, blood-stained, and mixed with gas—the tissues crepitating, on pressure, from its presence.

The gangrene may be limited or it may spread upwards, but when the action has attained its limit, the living tissues in contact with the dead become highly vascular, and a defined line, "the line of demarcation," at length appears. This vascular line goes on to ulceration, and, if left to take its course, to the separation of the whole slough from the living tissues: soft parts, and even bone, may be divided by it, the granulations on the new surface materially assisting the casting off of the slough. The deeper tissues of a limb thus affected, rapidly decompose and give rise to a horrible fetor; the extent of decomposition will depend much upon the fluids in the part. Should the limb be exposed the integument will soon dry and become black, and gradually wither, while the soft parts beneath will undergo decomposition.

This process is rarely attended with hemorrhage, the blood in the vessels coagulating during the sloughing action, and thus obstructing them. In exceptional cases, however, sloughing of the vessels ensues—the more rapid the sloughing action, the greater, apparently, being the liability to bleed.

Direct traumatic gangrene is also well illustrated in cases of extravasation of urine, or feces, and probably also by the action of some animal poisons.

The best examples of anæmic gangrene, *i. e.*, gangrene *caused by the cutting off of the arterial supply to a part*, are found after the application of a ligature to a large artery, such as the femoral, for aneurism or injury; or after the contusion of an artery, which often, either by laceration of its inner coats (*vide* fig. 118) or by other means, is followed by its occlusion. Embolic plugging of an artery, the gradual closure of a vessel from local arteritis or degenerative disease, are other causes of this kind of gangrene. In the same way is caused the abscess of the brain, or rather sloughing, that follows the application of a ligature to the carotid artery. In all these instances the part dies by starvation from want of blood, and the more sudden the act by which the supply is cut off, the greater is the probability of gangrene being the result. The sudden occlusion of a large artery, whether in old or young, is liable to be followed by gangrene. Its gradual occlusion, except in the aged, is more rarely followed by such a result, the collateral circulation preventing it. In the form of gangrene called "senile," it is very probable that arterial obstruction, the result of atheromatous arterial disease, or of embolic plugging of the vessel from the breaking loose of some portion of the diseased arterial coats, is the immediate cause of the gangrene; but the feebleness of old age, the degeneration of the tissues that have been badly supplied with arterial blood, coupled often with some slight local injury, are doubtless powerful agents in giving effect to the process. One or more of these agents may be the true cause of the gangrene, but in the majority of cases they are probably combined. When the gangrene is purely a dry withering or mummifying process, the cause is probably the simple want of blood supply; but when inflammation coexists, the gangrene will be moist, the feebly nourished tissues either from injury or otherwise, becoming inflamed from some accidental cause, and ultimately dying.

In the gangrene met with from arteritis or embolism in the young or middle aged, the dry one is the usual form—the parts becoming cold, bloodless, waxy, rapidly withering, turning black and then mummifying. When caused by embolism, the onset of the gangrene, or rather the early indication of the plugging of the vessel, is marked by a sudden shooting or crampy pain down the extremity, this symptom being speedily followed by those of "arterial gangrene."

When the occlusion of the vessel is gradual, this pain is not present, and the symptoms of gangrene are more chronic.

Gangrene from "cold" may be the direct result of want of blood supply, or may be indirectly caused by the inflammation due to excessive reaction *from* cold: this latter form is called secondary mortification. The gangrene following the use of the "ergot of rye" is dry, and follows precisely the same course of gangrene as that from arterial obstruction.

The best illustrations of gangrene *from obstruction—static gangrene*, as it might be called—are seen in such cases as strangulated femoral hernia; after the use of splints too tightly applied; after the prolonged employment of the tourniquet to check hemorrhage; in a tight paraphimosis; in the sloughing of protruding piles; in the gangrene of a limb from the pressure of an aneurism or tumor upon the chief venous trunks; in the sloughing of the legs, groins, or other parts of patients suffering from some obstructive heart disease. In all these the parts may die from blood stasis, though inflammation, more or less marked, with its products, has generally an important influence in producing the result.

Mortification is thus a compound process, and is brought about by mixed causes—direct injury, want of arterial supply, and blood stasis from mechanical obstruction to the return of the venous blood being the three main exciting elements of the affection. At the same time, in each of the three classes of causes thus grouped together, inflammatory action has secondarily an important influence. Feebleness of power, old age, or want of nutrition, or nerve supply in a part, renders a patient or tissue more prone to the action of these causes, and the process more active.

The constitutional symptoms associated with gangrene vary with its cause, but under all circumstances, a depressed condition of the ordinary powers is recognizable. In traumatic inflammation during the stage of excitement, the pulse may be rapid and the beat strong, the fever high, and other symptoms may be present indicative of sthenic action; but, when about to terminate in gangrene, all these symptoms will be marked by a sudden fall, the temperature of the body dropping four or five degrees, say from 104° or 105° to 99° F. Some interesting observations on this point by Mr. Pick will be found in 'St. George's Hospital Reports' for 1868.

When the mischief is extensive, and the gangrene spreads, what are known as typhoid symptoms may supervene. In the more acute cases death takes place very rapidly, but in the chronic, the constitutional symptoms are negative.

TREATMENT.—The most important point the surgeon has to bear in mind in the treatment of every form of mortification is, that the condition indicates a depressed state of the system; consequently the general treatment should be directed towards maintaining the patient's strength and cautiously building up the feeble powers by means of nutritious food, stimulants, and tonics, at the same time allaying pain by local and general soothing remedies, such as opium, morphia, or chloral, for nothing depresses more than pain.

The *cause* of gangrene has also to be considered, for its influence on practice is most important. To treat a case of gangrene, the result of a local injury, as one due to obstruction of an artery would be clearly wrong, and to deal with an example of this latter form in the same manner as with another due to blood stasis the result of mechanical obstruction to the return of the venous blood of a part, would be unscientific. I shall, therefore, consider the question of treatment as applied separately to the three groups of cases already formed.

Treatment of traumatic gangrene, when of a *limited* nature, need cause but little anxiety. It should be treated on ordinary principles of local cleanliness, by poultices, water-dressings, or the irrigation of warm water, with some antiseptic lotion, such as iodine lotion, sulphurous acid, Condy's fluid, carbolic acid, or chloride of zinc. When the slough has come away the surface is to be treated as an ordinary sore.

When the gangrene is more extensive and involving possibly a portion of a limb, *but yet defined*, whether caused *directly* by the injury or *indirectly* by the inflammation that followed, the expediency of removing the dead part by amputation is not to be disputed. No more of it, however, should be sacrificed than is absolutely necessary, and to insure this object the flaps to cover the end of the stump may be cut of any shape. Thus, in gangrene of the leg, it is better to amputate below the knee with any form of flap that can be made of sufficient size to cover in the end of the stump than at the joint, and it is far better to amputate at the joint than above it.

When, however, an injured limb is attacked with gangrene which is rapidly spreading, the difficulties are great. To remove it at once, as soon as the action has declared itself, would be to take away what often might be saved, or to do that which will not arrest the disease. To defer the removal, too often diminishes the prospects of recovery; and, subsequently the extension of the mischief, renders the amputation a more formidable one, or precludes the possibility of its performance. *It is wise, however, to amputate when the gangrene is extending, owing to the infiltration into the healthy tissues of the decomposing fluids from the parts.*

In a case of compound fracture, which is so bad as to suggest the necessity of primary amputation, but in which the surgeon has been desirous, if possible, of saving the limb, the first onset of an inflammatory action that assumes a gangrenous form should be met by amputation; while in a case less severe, where the injured limb has a good prospect of being made an useful one, an attack of inflammatory gangrene need not necessarily lead to its loss.

Where the gangrene is due to the injury, it will probably be limited, and may so terminate that a good limb can subsequently be secured. Where it is due to constitutional and not local causes, amputation of the limb will not arrest it; for the gangrenous action will in all probability attack the stump, and continue till it finds a limit or destroys life. If the patient lives, moreover, a line of demarcation will occur, and then amputation may be performed with a better prospect of success, whereas, if the patient dies, the surgeon will not have helped him to his end.

Gangrene from a local traumatic cause may be treated successfully by amputation, but a spreading gangrene the result of a general or constitutional cause cannot be thus dealt with.

In offering this recommendation it is right to add that it is against what is called authority. Erichsen says, "In traumatic gangrene, amputation should be performed as soon as the gangrene has manifested itself, without waiting for the line of demarcation." Spence writes, "In spreading gangrene, amputate without waiting for a line of demarcation." Pirrie says, "As the only chance of life, however slender, lies in immediate amputation, it ought to be performed at once, and high above the part affected." Brodie and Guthrie might be quoted for a like purpose, and H. Coote, in 'Holmes's Surgery,' ed. 2, says, "the indications for immediate amputation are so clear and generally acknowledged, that he who shrinks from the responsibility of the operation stands exposed to just reproof."

But these authors do not seem sufficiently to recognize a difference between the gangrene due directly to the injury and involving the injured part, and the rapidly spreading gangrene which begins at the seat of injury and travels upwards; the *former* being directly due to the accident and generally confined to its seat; the *latter*, although indirectly due to the accident, being set up by some inherent weakness in the general power, which the local injury renders manifest.

When the gangrene originates from a local cause, amputation is clearly the best practice; but when from a constitutional, it had better not be entertained till the action has ceased and a limit to the disease been formed. In Military Surgery there may be many reasons why this practice cannot be observed, for all conservative surgery, or treatment based on expectancy, has to be sacrificed to the exigencies of the moment.

Sir W. Fergusson was clearly led to this opinion on account of the absence of success he had met with in adopting the more usual practice, viz., amputation; for when he writes "I might, however, possibly in future resort to a similar practice, but should feel greatly inclined to wait for a line of demarcation," it clearly must be accepted as being against amputation in spreading gangrene.

How, then, it may be asked, is spreading gangrene to be treated? I reply, by tonics and local treatment based on general principles; by maintaining the part as free as possible from all fetid discharges; by local cleanliness and the use of antiseptic applications; but chiefly by using all means at our disposal to give free vent to fetid discharges and to relieve tension, employing incisions when necessary to secure these ends.

Under this practice, when nature is strong enough to check the progress of the disease, a limit to its extent will be formed, and the local affection will be amenable to treatment; but when no limit takes place, death will ensue, which amputation would not have arrested.

When amputation is deemed necessary, on the arrest of the action the limb should be removed as close as possible above the diseased part. There exists no necessity to sacrifice any tissue, and much less a joint, to make an amputation neat. The only point for consideration is, that the diseased tissue should be avoided, but beyond these no healthy structures should be sacrificed.

In the treatment of gangrene due to arterial obstruction, the objects of the surgeon should be to prevent its extension, and to assist, when called upon, the separation of the parts.

To carry out the first of these the mortified parts may be wrapped in some lint dipped in oil, with or without carbolic acid, as indicated by fetor; and the whole extremity should be raised to encourage the venous circulation, and surrounded with cotton wool to maintain its warmth.

Abundance of bland nutritious food should be given, aided with stimulants and tonics to assist digestion; the circulation, too, should be sustained, though anything like overstimulating is reprehensible. Opium also may be given to allay pain, the patient being kept gently under its influence. Where small parts only are implicated, then separation may be left to nature; but where hands or feet are involved in the gangrene, the surgeon should assist nature's process by amputation above or about the line of demarcation, as soon as indicated.

In "senile gangrene" the interference should be of the mildest kind, but when a limb dies from embolic plugging, occlusion of an artery, or from the effects of ergot of rye, amputation may be performed as soon as the line of demarcation has been indicated, that is, provided the general condition of the patient be such as not to forbid it.

Where "sphacelus" takes place after the application of a ligature to a large artery, early amputation is sometimes called for, it being at times wise to remove the limb above the line of ligature (after ligature of artery) rather than to wait for nature to indicate the point, particularly when the limb is œdematous from blood stasis and infiltrated with inflammatory products; this practice under these circumstances saving much constitutional disturbance and economizing power. In cases, however, in which the gangrene assumes the anæmic form and spreads slowly, a line of demarcation may be waited for, more particularly when the constitutional condition of the patient is good.

In the treatment of the third group of cases, those of "static gangrene," caused by the mechanical obstruction to the return of blood from a part, the first thing to be done is to remove the cause. In hernia this is accomplished by dividing the stricture, in paraphimosis by freeing the prepuce, and when it is the result of the application of a tourniquet or splints, by their removal, and so on. By this course, if the parts involved are not irreparably lost, a recovery may take place by natural processes, their venous circulation being aided by position and other means. When gangrene, however, has taken place in a limb from this cause, its early amputation is necessary, it being wiser to remove the dead part at once before the setting in of secondary inflammation which may spread and cause more loss of tissue; the seat of the mechanical force fairly indicating the extent of mischief.

In gangrene of a limb from a ruptured artery or aneurism, the same practice should be resorted to for similar reasons; delay, under all these circumstances, being unnecessary as well as injurious.

HOSPITAL GANGRENE,

or sloughing phagedæna, is an affection that attacks wounded or injured parts, and chiefly in over-crowded, badly ventilated, or ill-drained hospitals. At times it presents itself as if generated in a ward too closely filled with patients who have suppurating wounds; at others, as if conveyed into a ward by the introduction of a sloughing or fetid sore. Want of cleanliness in the treatment of suppurating wounds and want of attention to sanitary laws have undoubtedly much to do with its propagation, for the disease seems to be contagious as well as infectious, through its discharges. Its contagious character is admitted by all, though some dispute its infectiousness. Guthrie, however, in his 'Commentaries,' relates the following striking fact bearing upon the point:—"Burgmans says, that hospital gangrene prevailed in one of the low wards at Leyden, in 1798, whilst the ward above it was free. The surgeon made an opening in the ceiling between the two, in order to ventilate the lower or affected ward, and, in thirty hours, three patients, who lay next the opening, were attacked by the disease, which soon spread through the whole ward."

Two forms of the disease exist. In one the ulcerative action is the more violent, wounds attacked with it rapidly spreading; skin, subcutaneous and connective tissues all disappear under its action, small sloughs taking place at the same time. Blackadder relates how a vesicle forms and ulcerates, the ulceration rapidly spreading, leaving a sharp well-defined edge to the ulcer. This form of the affection Delpech designated "ulcerous," and Boggie "phagedæna gangrenosa."

In the second form the tissues die in masses, forming pale, ash-colored, pultaceous, horribly offensive sloughs; these sloughs giving the old term "putrid degeneration" to the disease. In one epidemic the ulcerative form will predominate, in another the sloughing, and, at times, it appears as if one form of the disease would give place to the other.

As a rule, though not always, an open wound seems requisite for the disease to fix upon. In 1849, when the wards of Guy's Hospital were *last* filled with such cases, a contused part often took on the action, the affection commencing as a vesicle the base of which turned at once into a grayish slough, which rapidly extended. When it attacked a wound, the edges or surface would cease to secrete, but assumed a gray color, and as a slough, would spread, small wounds enlarging even in twenty-four hours. When the slough had ceased to spread, ulceration would begin to throw it off; and the fetor of the slough, with the *débris* of the ulcerating tissues, formed a mass of decomposing material unequalled in any other affection. Skin readily died under the influence of the process on the connective tissue; but muscles became likewise involved; tendons and vessels gave way only in prolonged cases, and hemorrhage was rare. The parts around the wound showed small signs of change till the sloughing had ceased and ulceration had commenced, when the line of separation would be indicated by a red zone.

The constitutional symptoms of the disease in the epidemic I have witnessed, were absent at the outset, and there was certainly neither fever nor other disturbance to indicate the approach of the action; yet when the local disease had once manifested itself, great depression became very general. It was always remarked, however, that the constitutional symptoms were never in proportion to the extent of the local affection. When strong subjects were attacked the local mischief told but little upon their powers; while with feeble subjects the effects were more marked.

Military surgeons, however, have related that the constitutional often preceded the local symptoms. Hennan states this very clearly; and Thomson, of America, found a like result; while Blackadder, Delpech, Guthrie, and Macleod, found the local affection took precedence in point of time.

It would rather appear from the descriptions given of the epidemic at various times, that the ulcerative form is more commonly preceded by constitutional symptoms than the sloughing—the sloughing being, apparently, a local affection at the first.

During the late German campaign Professor Billroth met with a wound disease, which he had not seen before, and which he terms "diphtheritic phlegmon," or "diphtheritic infiltration." He describes three cases in which the diphtheritic appearance occurred soon after operations, and was speedily followed by fatal collapse. The entire muscular structure of the part became hard and stiff, from an indurated infiltration, the surface of the wound being of a pale gray. The affection was especially distinguished from gangrene by an absence of any rapid increase of the ulcerative process or of inflammatory redness in the vicinity; the surface of the wound exhibiting a lardaceous whiteness, and not the greasy pulpiness of hospital gangrene. The broad, hard infiltration so soon following the operation, might seem to be due to contagion, by means of the dressings employed, but this was scarcely probable. In its sporadic form it especially appears to affect the subjects of septic or pyæmic disease, and perhaps, certain conditions of the secretions inclined to coagulation may favor its production.

TREATMENT.—*Abundance of fresh air* is most essential, even to an air bath, as maintained by a constant current allowed to pass through the ward or room; isolation, the free use of such antiseptics as may be preferred, and close attention to all sanitary measures should be scrupulously observed. During the early stages of the disease irrigation seems to be the best local treatment. *Sponges should never be employed.* The next object should be *to take away all sloughs and putrescent material*, and this must be done by carefully cutting the existing slough with scissors or scalpel aided by the dressing forceps, and mopping the surface of the wound with cotton wool or tow, thus *thoroughly cleansing the whole surface of the wound.* The third aim is local applications to prevent the extension or return of the sloughing.

Of these applications nitric acid was formerly the chief, the acid being freely applied to the diseased parts, and carefully introduced into every hollow and excavation into which it could percolate.

To apply the acid, writes Wellbank, "the sore must be thoroughly cleansed, and all its moisture absorbed by lint or tow. The surrounding parts must next be defended with a thick layer of ointment; then a thick pledget of lint, which may be conveniently fastened to the end of a stick, is to be imbued with the acid, and to be pressed steadily on every part of the diseased surface till the latter is converted into a dry, firm, and insensible mass. The part may then be covered with simple dressings and cloths wet with cold water."

Dr. Goldsmith, of America, has spoken very highly of the value of bromine as an application, which arrests ulceration and turns sloughs into tough deodorized tissues. Others also, have adduced sufficient evidence to prove its value. It should be applied freely, as is the nitric acid, to the whole surface, its application being repeated when the sloughing or ulceration spreads. Iodine and the oil of turpentine have also been advocated, the latter, it is said, has the power to dissolve the sloughs and change the action of the disease. Delpech and some surgeons speak highly of the actual cautery, and when the galvanic cautery is to be had, it should be used—the object of all these different plans of treatment being to excite a new action on the surface of the wound, and to destroy the sloughing tissues which, doubtless, by mere contact, have a power of keeping up or propagating the disease.

When the sore is extensive, an anæsthetic should be administered during this local treatment. After the cauterization, the surface of the sore should be dressed with the permanganate of potash, carbolic acid, or iodine lotion; opium should be added to allay pain; bromine in solution, two drops to the ounce of water, is also beneficial.

Dr. Packard, of Philadelphia, prefers the use of powdered sugar or thick syrup, sugar being a hydrate of carbon which does not give up its oxygen and well known for its preservative powers in the case of meats. He dusted the parts with the sugar, and covered the whole with wet lint. When odor exists charcoal should be mixed with the sugar.

The constitutional treatment consists in abundance of light nutritious food, milk being administered as freely as it can be taken, with sufficient stimulants to maintain the circulatory system and assist digestion.

Tonics, such as quinine and iron, are often well borne in large doses, five grains of the former dissolved in half a drachm of the tincture of the perchloride of iron being a good recipe, or, when quinine cannot be taken, the tincture of nux vomica in ten-drop doses may be substituted.

Opium is an admirable drug when the ulcerative action is present, but in the sloughing stage it is not so satisfactory. It may be given in any of its forms. Chloral is probably a good remedy for a like purpose.

ERYSIPELAS.

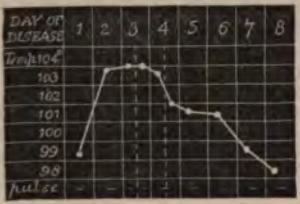
Erysipelas is a specific disease due to the presence of some blood poison that has probably been introduced into the body from without. It is intimately allied with other blood poisons, such as are found in scarlet or puerperal fevers, or septicæmia in any of its forms; for these poisons seem to be convertible. It is not so much an hospital disease as is generally believed, only 172 cases having taken place in Guy's Hospital in the five years ending with 1876 out of 9255 surgical patients which were admitted, or 1·85 per cent. No less than 253 cases were however admitted *with* the affection, and some of those recorded as having been transferred from one of the wards, simply passed through it.

It manifests its presence in three forms:—As a diffused cutaneous inflammation, "simple cutaneous erysipelas;" as a diffused inflammation of the cellular tissue, "diffused cellular inflammation;" and as a diffused inflammation of both skin and cellular tissue combined, "phlegmonous erysipelas;" the two latter being included in the expression "cellulo-cutaneous." The state of the system, the temperament and habits of the individual, have much to do in determining the form of the affection. When the disease follows an injury, it is called "traumatic; when it occurs spontaneously, it is styled "idiopathic."

The peculiarity of erysipelas lies in the diffused character of the inflammation and in its atonic nature. It is both *infectious* and *contagious*.

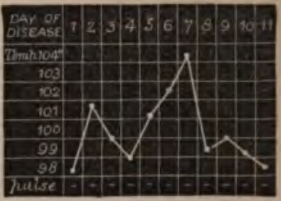
The attack is occasionally preceded by some constitutional disturbance, but as often as not such has not been observed; the severity of the general symptoms, moreover, in no way bears any proportion to that of the local disease. Febrile symptoms ushered in by chilliness and *rigor*, are the most common, the tongue being probably a foul one, and the bowels constipated or relaxed. As the disease advances the fever runs high; delirium of different forms appear and the pulse becomes quickened: but if full, it will always be compressible, and often irregular and intermittent. Towards the close of the disease, particularly when terminating unfavorably, the pulse will be small and weak. The temperature at the first onset of this disease as a rule rises rapidly, and, in its decline, falls as fast (*vide* figs. 4 and 5). When the temperature remains high, a bad prognosis should be given.

Fig. 4.



Thermograph of erysipelas supervening upon removal of the tarsal bones after the traumatic temperature had subsided, showing rapid elevation of temperature—nearly 5 degrees—at the onset of the disease and steady fall during convalescence. Case of H. B., æt. 32.

Fig. 5.



Thermograph of erysipelas in man, æt. 29, after removal of parotid tumor. Operation (day 1) followed by slight traumatic fever, day 2, and steady fall in temperature. Elevation of temperature, day 4, when blush first became visible, and steady rise for three days during increase of disease with rapid fall on its subsidence. Convalescence on 11th day.

C. de Morgan, Nunneley, and H. Bird assert, that if the pulse rise in frequency after the sixth or seventh day it is a very bad sign. I cannot, however, endorse this observation, although, as the end of the first week is about the time that complications appear if they occur at all, it may possibly be correct.

Frank has pointed out that when a patient has had febrile symptoms for some hours, attended with pain, tenderness, and swelling of the lymphatic glands of the neck, there is no doubt that erysipelas is coming on. Chomel held the same view, and Campbell de Morgan relates "that Busk is so convinced of the invariable occurrence of affection of the glands before erysipelas appears, as to consider it a pathognomonic symptom," and he believes that, although the blood became affected, the actual primary seat of the local inflammation was in the absorbent system. Sometimes swelling and excessive tenderness of the glands precede by many hours the appearance of a blush on the skin. These views accord well with those which Dr. Bastian brought before the Pathological Society in 1869, based on the post-mortem examination of a man who died from erysipelas in a state of delirium and stupor. In this case finding the small arteries and capillaries of the brain plugged with embolic masses of white blood-corpuscles, he suggested this condition as the cause of the delirium. He stated "that the blood change is a general one, and through every part of the body this blood is carried with its rebellious white corpuscles, so that we may expect that in all organs alike the same obliterations of small arteries and capillaries take place." Thus, when those of the liver are involved, jaundice may be produced, and when those of the kidney, albuminuria, these conditions being occasionally found in erysipelas.

If we accept Dr. Bastian's observations pathologically, and look to the condition of the white blood-corpuscles for an explanation of many of the phenomena of erysipelas, we may fairly admit the inference from clinical observations respecting the absorbent system to which Frank and Busk have called our attention, for the glands of this system and the white blood-corpuscles are generally recognized as having a close relationship. All these observations, however, require confirmation.

Local Symptoms.—In the *simple* form of cutaneous erysipelas, mere excess of vascularity, as indicated by the vivid redness of the part affected, is the one local symptom; this redness rapidly spreads. A sensation of heat or tingling in the part, and, in rare instances, small vesications may be present. On pressure the redness will disappear, to return directly the pressure is removed, but there will be no pitting of the parts to indicate œdema. In a day or two these symptoms will subside or disappear, the cuticle desquamating.

In the more severe form of cutaneous erysipelas, the vascularity of the skin will be as intense as in the simple, but it may be more livid. It will be associated with some perceptible thickening of the parts—the inflamed tissues feeling raised on palpation. This inflammation will spread rapidly in one or other direction, sometimes occurring in patches, and these patches joining. Where much cellular tissue exists, œdema will rapidly show itself, as in the eyelids or scrotum. Small or large vesicles form on the surface containing either a clear serum or a blood-stained or sero-purulent fluid, the latter form indicating great depression.

In the head or other parts where the skin is tight, the feeling of tension is very great and the surface looks shining, the features being altogether obliterated. There is rarely, however, much pain. The border of inflammation is invariably well defined.

The disease runs its course in about ten days. During the first three or four it spreads, and, having reached its height, declines, the redness and swelling gradually subsiding and the skin desquamating. In some cases a local suppuration takes place, and this is always to be suspected when any local redness remains after the subsidence of the inflammation. In the eyelids and other parts containing loose cellular tissue such a result is common. In the cachectic subject the disease is always more œdematous than in the healthy. When it attacks a wound the general symptoms are the same, but the local consist in arrest of secretion in the part, and then ulceration. Where union has existed, disunion appears, stumps and wounds sometimes reopening and discharging a thin ichorous fluid.

After the disease has subsided, repair is usually slow, but at times, it goes on healthily to complete recovery.

Simple erysipelas, unless in the feeble or cachectic, is rarely a disease of much danger. When it attacks the scalp after head injuries it is exceptional to find it followed by bad consequences. In free living subjects, and in others who have bad viscera, it is a dangerous affection, lighting up latent disease that often proves fatal.

Where the erysipelas attacks the mucous lining of the throat, fauces, or larynx, it may from mechanical causes, threaten life.

In some cases the disease will affect different parts of the body consecutively, or leave one spot to attack suddenly another. Such cases usually indicate want of power, and too often are found in those who have some organic disease of the kidney or other excretory organ.

Diffuse cellular inflammation may clinically be looked upon as a form of erysipelas, the disease attacking primarily the cellular tissue instead of the skin. It is characterized by the same diffused form of inflammation and by the same atonic character. It is, however, more frequently the result of some local injury such as a punctured or dissection wound than is the simple form, and it is even found in patients from whom no such history can be obtained. It is generally associated with absorbent inflammation and glandular enlargement.

The disease appears as a diffused swelling and induration of the cellular tissue of the part affected, the tissues feeling infiltrated and brawny, and the skin tense from over-distension. When suppuration or sloughing of the cellular tissue has taken place, fluctuation or crepitation will be detected or the parts feel boggy. The skin, if not previously inflamed, will now participate in the disease; it will inflame, ulcerate, or slough, to permit the escape of the pent-up pus or sloughing cellular tissue. When resolution takes place at an early period of this affection, the skin may escape uninjured, but such a result is rare.

The constitutional symptoms attending these changes in the cellular tissue are always those of great depression. The febrile symptoms will be of the typhoid type, the pulse feeble from the first although rapid, and the disposition to sink very marked. Profuse sweating is an early and constant symptom. Delirium also is sometimes present. Visceral complications are, as a rule, the cause of death, the connection between this affection and pyæmia being very close.

Phlegmonous erysipelas is a combination of the two former. It is far more serious than the simple, and as much so as the cellular inflammation. It is characterized by a diffused inflammation of the skin and cellular tissue together, the parts having a strong disposition to suppurate and slough. Resolution is almost unknown as a termination of the disease, one case differing from another only in the extent of the destruction of tissue with which it is accompanied. It is commonly the result of some punctured wound or injury involving the skin and cellular tissue beneath, and begins locally as a brawny infiltration of a part, the skin presenting erysipelatous redness, of a dusky hue. To the finger the parts will feel more solid, and pit on pressure; the boundary between the inflamed and uninflamed skin will be less marked, and outside the limit of the redness the skin will feel unnaturally firm, and the cellular tissue beneath as if infiltrated.

As the disease progresses, and the cellular tissue beneath the integument becomes infiltrated with inflammatory products, the skin will be made tense, and cease to pit on pressure; uniform hardness of the tissue giving place to a sense of fluctuation, as of fluid, or to a boggy, quaggy, crepitating feel of sloughing cellular tissue.

If the case be left to nature, the skin will become thin and ulcerate in parts or slough in masses, to give way to the pent-up and sloughing tissues. Phlyctænæ appear over the dead portions of skin as in other forms of gangrene, while the pus and sloughs which escape are always fetid. In bad cases the whole cellular tissue of a limb, with large portions of integument, may die in this way; bands of skin, held down by fascia, being commonly felt, which, during recovery, will become the centres of cutification.

In the ordinary run of cases this diffused infiltration of the cellular tissue is confined by the fascia to the subcutaneous tissue; but in some instances, when the cellular tissue that separates the muscles becomes involved, the case assumes a far more serious aspect, for the suppuration is then of a burrowing kind, the sloughing more extensive, and the prospect of recovery, with an useful muscle, becomes very slender, because muscles and tendons may not only slough wholly or in part, but on recovery taking place, they become so closely bound together with all the other tissues that they are useless as moving organs. From this cause, after phlegmonous inflammation of the hand and forearm, a stiff and immovable extremity is often met with, the hand becoming a kind of fin.

The constitutional symptoms attending phlegmonous erysipelas vary considerably; their severity depends much upon the rapidity with which the disease spreads. They are, however, in character the same as are to be found in other forms of the affection, though probably more severe. The rigors are more marked, the fever higher, the pulse more rapid, and the tendency to fall in power always marked. Thus, in the second stage of the disease—the suppurative or sloughing—the rigors frequently recur; cold sweats and fever intervene as in an ague, these attacks being indicative of suppuration. When the local affection is undergoing repair, or, at any rate, has ceased to spread, and these "false ague fits" persist, some internal or visceral complication may be looked for, as the blood becomes poisoned as in septicæmia, and often to the extent of destroying life.

The pathological appearances met with in cases of death from erysipelas have been kindly drawn up for me by Dr. J. F. Goodhart, after a careful analysis of the post-mortem records of the hospital. They admit of being classified as *local* and *general*, the former including all those morbid changes which occur in the primary focus and in the surrounding parts directly extending from it; the latter, the various alterations of blood or tissue found in any secondary foci or in the system at large.

The *local* changes vary according to the severity of the disease and the rapidity with which it causes death.

In the slighter forms, where it has not been the immediate cause, but has supervened as an intercurrent affection in the course of some other disease, it may often happen that no morbid appearance is visible post-mortem indicating erysipelas. Again, the skin alone may be affected either with a mere faint purple discoloration or with slight œdema, or, the the cuticle may be raised into bullæ or separated more or less around. In more pronounced cases, the areolar tissue beneath the skin and along the tendons and intermuscular septa has numerous minute ecchymoses and extravasations of blood in it, and is often soaked with yellow serum or gelatinous matter, apparently produced by a delicate fibrinous coagulum; in the more prolonged or in severe cases, the serum is replaced by good-looking pus. Ecchymoses in the subcutaneous areolar tissue are very common even in cases where death has been very rapid and no other morbid appearances are seen.

It is characteristic of the further changes that there is no tendency to the limitation of the disease around the primary focus; the pus or serum leads to the formation of no abscess sac, but spreads along the subcutaneous tissues and intermuscular septa, sometimes even making a complete dissection of some of the muscles.

There may or may not be phlebitis in the parts. Where it exists, the interior of the veins affected is discolored and filled with a grumous chocolate-colored fluid, while the inner surface of the vein wall is rough from the inflammatory processes it has undergone and the adhesion of small particles of clot. Where the disease has existed some time a tube of semi-organized clot may line the vein, and within that will be found the broken-down clot which it is often impossible, microscopically, to distinguish from pus.

It is quite as common, if not more so, however, to find the vessels unaffected as to find them plugged. Pus may even run along their course, sometimes apparently in their adventitia, but generally immediately outside it, and still lead to no clotting. On microscopical examination in these cases the pus is seen to lie in smooth-walled channels which in all probability are lymphatic spaces (suppurative lymphangitis).

The neighboring lymphatic glands, *i. e.* those in the groin if the disease be situated in the leg—the axillary if in the arm—are usually swollen, red, and ecchymosed on section and are frequently surrounded by the same kind of serous fluid as is found in the immediate neighborhood of the primarily diseased tissue. The tissues of all the diseased parts are said to be crowded with small vegetable organisms called bacteria. These constitute the local changes. It may be as well to add, perhaps, when erysipelas affects the scalp, that a yellow color of the vault of the skull is often observed, and also that suppuration between the bone and dura mater and suppurative arachnitis and meningitis are not very unusual sequences. About the neck it may be followed by œdema glottidis, and occasionally by pericarditis or suppurative inflammation of the mediastinum.

The morbid appearances in the system at large are similar to those found in septicæmia from other causes, viz., ecchymoses about the pleura and pericardium; a fluid and sometimes treacly state of the blood, congested kidneys, and a softened state of the liver and spleen. So soft, indeed, is the latter organ that were it not for the capsule it would at times lose all shape. The blood has been said to contain bacteria, but I have never found such during life, though they are sometimes present when the blood is examined some hours after death. In addition to these *general* changes, separate foci of diffuse cellulitis are found—in both forearms and in the calf of the leg, for instance, after a primary erysipelatous state of the scrotum—and in at least two recorded cases a similar diffuse cellulitis or myocarditis has been noticed in the muscular wall of the heart. Patients with erysipelas are also liable to suppurative peritonitis and pleurisy, which, though commonly so, are not necessarily determined by the presence of a neighboring wound. A subject of hernia or ovariotomy at a time when erysipelas is rife will be likely enough to die of suppurative peritonitis; while another who has undergone an excision of the breast may die of a similar form of pleurisy without showing any external evidence of erysipelas.

A wound, however, is not necessary. For example, in a post-mortem made not long since, a lady about sixty had been nursing a friend who died of some febrile affection called "low fever." Within a few days she herself became exceedingly ill and died quickly. The inspection revealed what had only been evidenced by the faintest blush on the skin during life—viz., an early suppurative inflammation of the cellular tissue of the right axilla and pectoral region, and pus on the surfaces of both pleuræ; all this without any external wound whatever.

As occasional causes of death in erysipelas may also be mentioned acute lobar pneumonia, and a diphtheritic sloughing of the mucous coat of parts of the bowel; while to complete the history, it must also be said that at times when erysipelas is present in an hospital or its neighborhood, not only are cases of pyæmia with the known manifestations frequent, such as abscesses in the viscera and pus in the joints; but patients suffering from chronic suppuration become feverish and die without, it may be, any adequate cause appearing in the viscera.

In this description of the pathological appearances found in erysipelas no attempt is made to distinguish between it and cellulitis. The morbid changes in both are the same, and it is as impossible in the deadhouse as at the bedside to separate the two.

TREATMENT.—The disease in all its forms being essentially an *atonic* one, nothing like "antiphlogistic" remedies are to be entertained, and in the simpler forms which have a tendency to run a definite course, the practitioner has merely to guide his patient through the attack, and to ward off whatever might prove injurious. With these objects when the patient's powers are good, and no indications of feebleness manifest themselves, a mild aperient or purge, to clear out the bowels, with bland nutritious food, such as milk and beef-tea, are probably sufficient remedial means; the disease, on the third or fourth day, attaining its height, and then declining.

Should any feebleness or want of power appear at the beginning or during the course of the disease, tonics are indicated, and of these iron seems the best. The tincture of the perchloride in half-drachm doses, or more to an adult frequently repeated, with or without quinine or strychnia, acts at times like a charm. Its use was introduced to British surgeons by Dr. H. Bell, of Edinburgh, in 1851, and stands unrivalled, although Velpeau, in 1841, had previously declared its value. It doubtless often cuts short the disease.

In the earliest stage of the affection, when the first patch of inflammation appears on the skin or around a wound, an emetic may at times abruptly check the attack.

When food cannot be taken, stimulants must be substituted, and it is often possible to introduce into them, and particularly into stout, some essence of meat. The form of stimulant must depend upon circumstances, but, as a rule, that which the patient has been in the habit of taking is the best. When brandy is given it should be mixed with milk or egg, it being always better not to give stimulants alone. The amount must be regulated with care, for over-excitation of the system is always bad.

Hypnotics or sedatives should be used with caution, for they are not usually beneficial. Of these, chloral seems less liable to disagree than opium; camphor and henbane in five-grain doses, are thought well of by some, while ammonia is as highly recommended by others.

In phlegmonous and cellular erysipelas the same principles of practice are applicable. In the suppurative or sloughing stages it is necessary to give abundance of good food of all kinds, and stimulants in proportion; strong animal broths and milk are the best forms of diet.

Local Treatment.—The inflamed parts should always be kept warm and raised, air being excluded from the surface; consequently, when the head and face are implicated with simple erysipelas, the old practice of flouring the parts is effective. Warm fomentations, however, where they can be applied, are the best, especially when medicated with poppy, hop, or chamomile. Cold applications are injurious.

In the face and head, when the parts are very tense and painful, relief is readily given by following the practice of Sir R. Dobson in puncturing the skin with a series of small punctures—oozing of blood or serum being encouraged by warm applications.

Mr. Luke thought highly of the free use of collodion, applied over the part; Mr. Norris, of the compound tincture of iodine; Mr. Higgenbottom, of a solution of nitrate of silver, twenty grains to the drachm of water; others, of the sulphate of iron, a drachm to a pint. The tincture of the perchloride of iron has also been recommended for the same purpose. I have employed at times all these, likewise a mixture of iron and glycerine, but none of them have any certain power of arresting the progress of the disease; in some cases success seems to attend their use, but in others they appear valueless. Some American surgeons speak strongly in favor of the application of a solution of bromine on lint, with oil-silk over the whole; and quite recently the subcutaneous injection of a solution of carbolic acid has been highly spoken of. Mr. De Morgan believes there are not many things more comforting to the patient than a thick layer of cotton wool placed over the part, to which powder or collodion has been applied.

The local treatment of the cellulo-cutaneous forms of the disease must be conducted on the same principles as the simple, but as soon as anything like tension of the integument appears—this tension being clearly caused by the presence of inflammatory exudation in the subcutaneous tissue—incisions should be made deep enough to allow of the escape of the effused serum from the cellular tissue beneath the skin, and long enough to relieve the tension of the whole. Some, and amongst them the late Sir W. Lawrence, recommended the incision to be free, so as to extend the whole length of the affected part. Others, among whom I claim a place, prefer a greater number of limited incisions. These limited incisions answer the same purpose as the long, and are not attended with so copious a hemorrhage, or with so great a risk to life. Even after these the bleeding is at times profuse, but it may generally be readily arrested by elevating the limb and by temporary pressure.

When suppuration and sloughing exist the surgeon must let out all matter as soon as formed, for there is little doubt that the disease is kept up by its presence. The opening into these abscesses should be free, and their cavities kept clean by careful washing out at each dressing, a detail which adds materially to the comfort of the patient and the well-doing of the case. Condy's fluid or iodine lotion should be employed. De Morgan prefers a solution of chloride of zinc, fifteen grains to the ounce. Water dressings should be applied to the parts, and frequently changed, a warm fomentation over the lint being often useful. Poultices are not so good, although at times patients say they derive the most comfort from them. During the period of repair the surgeon will often have to lay open sinuses. When the sloughing has been very severe amputation may be called for.

It has ever to be borne in mind that erysipelas is highly contagious and infectious. In hospital practice, consequently, every case, as it arises, should be separated from others in which wounds exist, and transferred to a separate ward. All dressings and towels as they leave the ward or chamber should be burned or disinfected; and a sponge should never be used. Plenty of fresh air ought to be admitted into the room, but no draught; and disinfectants should be distributed freely about. No medical practitioner under any circumstances should go direct from a case of erysipelas to a midwifery case, or to dress a wound of any sort, accidental or surgical. If he is obliged to attend a labor when in charge of such a case, he should allow as much time as possible to intervene before doing so, and then should attend only after having changed his clothes and carefully disinfected his hands, for there is a direct connection between erysipelas and puerperal fever.

ERYTHEMA.

Erythema finds its place here, as in its clinical features it bears some resemblance to the simple cutaneous erysipelas, and has been mistaken for it. It appears as a roseate or more vivid injection of the skin, of a local or general character, disappearing on pressure, and accompanied with some slight degree of œdematous swelling.

In its mere *transitory* form, when it appears as a cutaneous hyperæmia, it may be regarded as a symptom of some bowel or intestinal irritation, induced by irregularity in diet, or other cause. In so-called bilious subjects it is by no means uncommon, a local patch of redness on some part of the face, or other part of the body, often indicating the approach of a "bilious attack." It is found, also, where organic disease of the intestines is present. In other cases it precedes an attack of smallpox, attends vaccinia, and is common in children.

Hebra gives the term *erythema fugax* to all these symptomatic forms of erythema.

Erythema, as a *disease*, more commonly attacks the extremities than the trunk, and the dorsal surfaces in preference to other parts. When the efflorescence appears in small patches of papules or tubercles upon the fingers or hands, the terms *E. papulatum* and *E. tuberculatum* are respectively given.

When these patches assume the form of a red ring, the term *E. annulare* is applied to it. When a second ring forms around the first, before it has passed away, or when it is represented by a small spot, the *E. iris* is formed; and where many such circles or half-circles appear together, and touch or coalesce and spread, the *E. circinatum* and *E. gyratum* are respectively present. Wilson mentions a case in which the *E. gyratum* covered the whole body; but all these different forms of erythema must be regarded as different stages of the same disease. Hebra says, "it will depend on the period at which the patient comes under medical observation whether the case shall be diagnosed as *E. papulatum* or *E. gyratum*." He gives one term to the whole, *E. multiforme*. As the disease subsides, a slight desquamation follows, and then some small deposit of pigment. Mr. Morrant Baker describes an *Erythema serpens* which follows a slight, probably poisoned abrasion, and spreads in a circular manner, leaving the injured part well. It generally occurs in the hand. ('St. Barthol. Hosp. Rep.' vol. ix.)

All these forms run a definite course, and have a tendency to get well, lasting from one to three or four weeks. They require for treatment little else than a well-selected diet and attention to the bowels.

Erythema occurs at times during the secondary stage of cholera.

The erythema that precedes or accompanies an attack of elephantiasis is worthy of notice.

Erythema nodosum, however, is a more definite affection; it is found in both sexes, but more commonly in the female; it is also usually seen upon the legs, but not rarely upon the arms as well as other parts of the body. It shows itself in raised and tender oval patches of very variable size, and of a red color; some being the size of a sixpence, others that of an orange, and these patches at times join. At first they are of a bright red color, but as they die away they become of a livid hue, appear like bruises, and lastly are of a yellow tint. The cuticle always desquamates. When the disease is limited there may be no constitutional disturbance, although occasionally some febrile symptoms appear, and there is usually some evidence of derangement of the digestive organs with a foul tongue. As often as not, however, the local disease is the first symptom that attracts attention. The eruption is often symmetrical. When it appears over the tibia and the skin is very red and painful, it is often mistaken for some more serious affection, such as periostitis; but the absence of the severe constitutional disturbance which commonly attends this affection, ought to prevent such an error. The history of the case is enough to distinguish it from a bruise; and the different centres of redness or congestion from erysipelas.

Its *treatment* is simple. Saline purgatives, tonics, and a carefully regulated diet are, as a rule, sufficient in a general way; and the application of a lead lotion to the inflamed part, with elevation of the limbs, is generally all the local treatment that is required; but in exceptional cases warm fomentations, with or without poppy decoction, give greater comfort.

ON TRAUMATIC FEVER, SEPTICÆMIA, AND PYÆMIA.

Inflammatory fever, surgical, suppurative, or traumatic fever; septicæmia, ichoræmia, puerperal fever, and pyæmia, may all be considered as so many different names for, and manifestations of, one condition, viz., *blood poisoning*.

In inflammatory and surgical fever "the returning fluids of the inflamed part, its venous blood, and its lymph, are the agents of general infection" (Simon), the poisoning being "due to the introduction into the torrent of the circulation of toxic substances produced by the organism itself" (Maisonneuve), the poison being probably derived from *disintegrated tissues and generated from within the body.*

In septicæmia, ichoræmia, puerperal fever, and pyæmia, the absorption of *putrid* inflammatory products, or of pus or pus-forming material, or of some other poison, whether from a wounded part or not, is the undoubted cause of the disease; *the poison being taken into the body*, either by the veins or by the absorbents from without. Traumatic or surgical fever may, however, pass into septicæmia, and this into pyæmia, the first being the mildest form of blood poisoning, the last the most severe. Surgical fever generally ends in recovery, pyæmia after the formation of secondary abscesses, either in the viscera, joints or connective tissue, in death.

One and all are ushered in by very similar general symptoms, and an outline of those met with in a typical example of inflammatory fever will be found in a former page; "but practically the affection shows numberless grades and differences and complications. First, there are wide differences of degree and character, for in proportion as the local process is less acute and less extensive there is less attendant febrility; and in proportion as the local process has to invade fewer successive strata of texture, the fever is of shorter course. On the one hand, it may be so slight as readily to escape notice, and may end within a few hours of its commencement; on the other hand, it may last in full force during many successive days, and may be so severe as to shake the patient's life to its foundation; and, besides these differences, there are varieties of result, sometimes from complicative local conditions, sometimes from peculiar susceptibilities of the patient. If the wound become the seat of some large textural disorganization, with consequent soakage of putrefying material, more marked signs of *blood pollution* may be expected to mix with or supersede those of common inflammatory fever; the patient's general state will then incline to be one of depression and apathy; his tongue will be more than commonly foul, and fetid diarrhœa will probably exist; or if, perchance, during the local process it happen (as is especially apt to be the case where cancellous bone-structure is affected) that pus passes up a vein into the general stream of blood, the patient's improvement is abruptly cut short by the *severe recurrent rigors and sweating of pyæmia*, accompanied by local signs of secondary suppuration in parts to which the pus is conveyed." (Simon.)

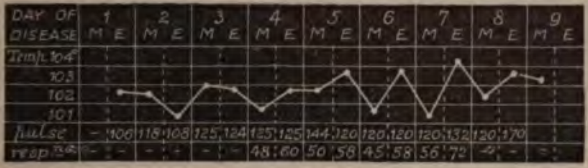
Confirmed blood-poisoning, therefore, is characterized not only by all the symptoms of inflammatory fever, but by *severe rigors* breaking in upon the febrile symptoms; by *sudden and marked variations of temperature* (*vide* fig. 6), by *profuse sweats and great depression of the patient's powers;* and when these symptoms occur in the course of an attack of inflammatory fever, severe blood-poisoning is certainly indicated; the gravity of the attack being measured by the intensity of the symptoms. We generally meet, moreover, in pyæmia with local signs of inflammation of some internal organ or external part of the body, and this inflammation runs on to the formation of *metastatic or secondary abscesses* as they are called. When an internal organ is involved in this disease the result as a rule is fatal. When suppuration attacks the integuments or extremities, although it may be severe, there is always some hope of recovery. It is an interesting clinical fact that these two different forms are rarely met with in the same subject. They may for clearness be separately called *internal* and *external* pyæmia, or *acute* or *chronic;* pyæmia, when involving internal parts, being generally rapid in its course and fatal; and when attacking external parts, it is as a rule chronic; at times, however, the latter may supervene upon the former variety.

In many cases of pyæmia a peculiar sweet, hay-like odor of the breath is undoubtedly present. Some authors, and Braidwood is amongst them, look upon this symptom as pathognomonic.

Traumatic fever, when it occurs, generally makes its appearance from the second to the ninth day after an accident or operation, and seldom lasts over a week. In a simple case it may subside after twenty-four hours, and, in a severe one, it may continue for a week. When a *relapse*, or a second sudden rise of temperature takes place, grave mischief may be anticipated—some local inflammation, internal or external, being thus indicated. Billroth has described this second attack of fever as "secondary fever." When it runs on for a more lengthened period than a week severe complications are sure to exist to keep up the symptoms. During its course the temperatrue of the body, naturally 98·6° F., may rise suddenly 5° or 6° F., and in ordinary cases its fall is as a rule gradual; while with its fall defervescence takes place. Should the fall be sudden, a general breakdown of the powers of the patient is indicated, and under these circumstances sloughing of the wound may be expected. The rise of temperature is generally accompanied by an arrest of secretion or some change of action in the wound, but the fall of temperature indicates the on-coming of suppuration.

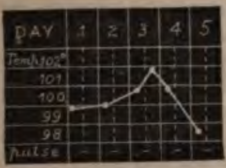
These points are well seen in the following thermographs, figs. 6, 7, 8, 9, and 10:

Fig. 6.



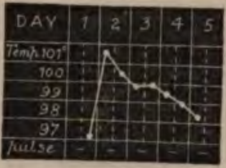
Thermograph of acute ostitis of the tibia in a boy, æt. 16, following a blow; admitted into Guy's on the fourteenth day with pyæmia which destroyed life on ninth day. The table well shows the fluctuation of temperature which is found in pyæmia with the night and morning variations.

Fig. 7.



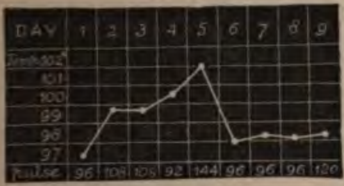
Thermograph of traumatic fever, rise for three days, sudden fall, after amputation at hip-joint, in a boy æt. 9, terminating in recovery.

Fig. 8.



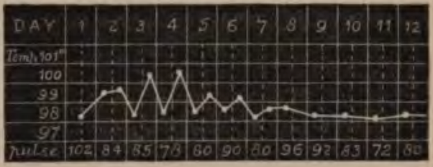
Thermograph of traumatic fever, sudden rise and steady fall after amputation of the leg for disease of foot in man æt. 52, terminating in recovery.

Fig. 9.



Thermograph of traumatic fever after operation for ruptured perineum. Fever at its height on fifth day, when quill sutures were removed, after which there was a sudden fall and a steady convalescence. Patient æt. 45.

Fig. 10.



Thermograph of traumatic fever after ovariotomy in a woman æt. 43, ending in recovery. Temperature never rose above 100.

It is, however, important to know that traumatic fever is by no means a necessary consequence of an injury or operation, however severe; that it may follow a trivial injury or fail to follow a severe one; and that it is quite impossible to predict its occurrence under any circumstances. After a large number of capital operations it is entirely absent,—I should say after one third,—and since the practice of the torsion of arteries has been adopted and wounds have consequently been freed from the presence of such foreign bodies as ligatures, the number of cases in which it is absent has decidedly increased.

When blood poisoning attacks a patient the subject of a wound, whether caused by operation or injury, it is generally to be observed that the secretion of the wound becomes sanious, serous, or fetid; probably it will be arrested, and the surface will become glazed or glassy or perchance assume a sloughing action. The integument around the wound will often have an erythematous blush, or acquire a peculiar leaden, dusky appearance, which is somewhat typical. Union if progressing will cease or disunion may result. When any internal organ is implicated, special symptoms indicative of disturbance of its functions will be present. When the ***brain*** is involved there will be sleeplessness or delirium of a low muttering kind, some unconsciousness from which the patient can be roused only to relapse—"***relapsing unconsciousness***,"—and in rare cases acute delirium and mania.

When the ***respiratory organs*** are involved—and it may be stated that they are so far more frequently than any other—difficulty of breathing, with a harsh dry cough, and perhaps viscid blood-stained sputum, are the prominent symptoms; occasionally pleuritic pains are present, or symptoms of bronchitis, with great dyspnœa.

When the *abdominal viscera* are affected, nausea or sickness is a prominent symptom, and profuse diarrhœa; the latter in some cases apparently carries off the poison. When anything like sallowness of the skin or jaundice appears, hepatic abscess should be suspected; and, under these circumstances, there will often be pain in the region of the liver. At the same time the reader must remember that a slight degree of jaundice is often present without hepatic suppuration. The urine is rarely altered either in character or in quantity, although at times it is scanty and dark colored. When severe or dull pains are experienced in a joint, suppuration should be suspected; and anything like so-called rheumatic pains occurring in a patient with pyæmia becomes a source of suspicion; "rheumatic" pains in blood poisoning too often mean joint or bone mischief of a suppurative kind. It is also remarkable how slight the symptoms often are in these cases when severe local disease exists. This fact demands that the surgeon should ever be on the watch to detect anything like local changes; inasmuch as it is a pathological truth that there is no organ or tissue of the body in which suppurative disease may not take place in a case of blood poisoning or pyæmia; and it is certainly true that the existence of severe local disease is too often only first discovered on the *post-mortem* table.

What then, it may be asked, are the *pathological conditions found after death* in a case of blood poisoning or pyæmia—using this word in a general sense?

The analysis (shown in the following table) of 203 fatal cases, which I have collected from the records of Guy's Hospital with the sanction of my colleagues Drs. Wilks and Moxon, by whom all the examinations were made, will answer this question.

ANALYSIS OF 203 FATAL CASES OF PYÆMIA.

Nature of accident or disease.	Number of cases.	Lungs.		Liver.		Kidneys		Spleen.		Brain.		Heart.		Joints.		Cell-tissue.	
		Cases.	Alone.[1]	Cases.	p. c.	Cases.	p. c.	Cases.	p. c.	Cases.	p. c.	Cases.	p. c.	Cases.	p. c.	Cases.	p. c.
Compound fracture	26	23	$11_{42·3}$	9	34·6	3	11·5	1	3·8	—	—	—	—	4	15·3	3	11·5
Amputation after compound fracture	38	34	$14_{36·9}$	15	39·4	2	5·2	6	15·7	—	—	—	—	4	10·5	3	7·8
Amputation for disease	29	24	$14_{48·2}$	6	20·6	2	6·9	2	6·9	2	6·9	—	—	2	6·9	4	13·8
Injury to scalp and skull	11	11	$1_{9·}$	7	63·6	—	—	—	—	5	45·4	—	—	1	9·	2	18·1
Inflammation and suppuration of soft parts	33	30	$9_{27·}$	8	24·2	8	24·2	5	15·1	2	6·	5	15·1	8	24·2	5	15·1
Disease of urinary organs	22	22	$11_{50·}$	—	—	10	45·4	—	—	1	4·5	1	4·5	—	—	1	4·5
Disease of bones and joints	28	27	$9_{32·}$	6	21·4	8	28·5	4	14·2	—	—	4	14·2	6	21·4	2	7·1
Operations on soft parts	5	5	$2_{40·}$	1	20·	1	20·	1	20·	—	—	1	20·	—	—	1	20·
Carbuncle	6	5	$2_{33·}$	3	50·	2	33·3	—	—	1	16·6	2	33·3				
Burns	5	5	5_{100}														
TOTAL	203	186 or 91.6 per cent.	78 or 38·4 per cent.	55[2]	27·	36	17·7	19	9·3	11	5·4	13	6·4	25[3]	12·3	21	10·3

[1] In which the lungs were alone involved, with per cent.

[2] Alone in two cases only, in all others lungs involved.

[3] Sterno-clavicular in eight.

Pathological Conditions from Pyæmia found after Death.

The lungs.—The most prominent fact indicated by this table has reference to the lungs, for it proves that in the larger proportion of fatal cases of blood poisoning these organs are implicated, and further, that in many they are the only parts involved. Lung mischief was found one hundred and eighty-seven times in two hundred and three cases; while in seventy-eight cases, or thirty-eight in every hundred, the lungs were the only organs affected. *Lobular pneumonia* is the form in which the disease is generally found;

and when even a lobar pneumonia is present, it can usually be made out to have originated in lobules, and to have spread from them as centres. This lobular pneumonia, like the lobar form, is also generally seen in the *lower lobes*, and not at the apices; and nearer the surface than the central parts. The earliest indication of disease is a lobular pneumonia, and "subsequently," says Wilks, "these congested spots are found to contain inflammatory products, and thus we have red hepatization, suppuration or sloughing," all these stages of inflammation being visible in individual masses. Associated with this lobular pneumonia some *ecchymosis* of the surface of the lung will generally be found—a purpuric condition in fact—strongly suggestive of blood poisoning. Pleurisy, moreover, generally exists, the fact being accounted for by the superficial position of the lobular pneumonia.

The liver, like the lungs, is also attacked in its lobules. These may be found only congested, or in any intermediate condition between this the first stage of inflammation, and the last, viz. that of suppuration, or sloughing. At times this organ is filled with small abscesses. When these abscesses approach the surface of the liver, they may burst and give rise to a general peritonitis. The liver was involved in this affection twenty-seven times in every hundred cases, and almost always in association with disease in the lungs. Thus, out of fifty-five cases in which the liver was affected, in only two were the lungs uninvolved. It would appear, likewise, from the table that the liver is more frequently the seat of pyæmic suppuration after injuries to the head than after any other affection, and that it is rarely found involved after disease of the urinary organs and burns.

The kidneys.—When these organs are affected, it is in the same manner as the lungs and liver, small isolated points of suppuration being found, surrounded by a zone of congestion either on their surface or in their cortical structure. They are not affected so frequently as are the two former organs—not oftener, indeed, than seventeen cases out of every hundred. They are more frequently found involved after disease of the urinary organs than of any other, and after suppurative disease of the cellular tissue, particularly of that surrounding the shafts of bones.

In the *spleen*, large abscesses are often present. Suppuration may likewise be found in the *brain, heart, prostate, testis, tongue, thyroid gland*, and, in fact, in any portion of the body. In the cellular tissue of the trunk and extremities a diffused suppuration is very common, as it is also common in the joints.

When inflammation attacks serous membranes, such as the pleura and peritoneum, there seems good reason to believe that it arises from the extension of disease from the lung, liver, or spleen; but in the joints no such extension can be made out. The sterno-clavicular articulation is more frequently involved than any other, for I find that out of the twenty-five instances in which joint complication existed, this was involved in eight. Any joint may, however, be affected. In some cases the articulation is only filled with an increase of synovia, in others the contents are puriform—sometimes purulent. At times the pus in the joint appears to be so slightly irritating that the cartilage and the synovial membrane are uninjured by its presence, whilst at others it is so destructive as to produce complete disorganization, the bones forming the joint being under these circumstances exposed, and at times necrotic. When these changes occur they are, probably, sometimes due to acute articular ostitis.

The skin has occasionally a *vesicular* or *pustular eruption* upon it, and too frequently *purpuric spots* or patches are present, which at times lead on to mortification; and in connection with this subject "we may mention another evidence of the blood disease in the rapid decomposition of the bodies and the marking of the veins on the surface. Thus, before the body is scarcely cold, there may sometimes be seen the blue and red coursing of the veins and the coloring which has exuded from them into the tissues." (Wilks.)

Lastly, it is to be noted that it is exceptional to meet with any evidence of *phlebitis*, general or local; and this leads me to consider, although briefly, the now already abandoned and untenable theory that phlebitis, or inflammation of a vein, is the invariable cause of pyæmia.

The most telling evidence against the theory is the one just mentioned, that it is only in exceptional cases of pyæmia that any evidence can be found of phlebitis; and the second is almost equally strong, because "so far from phlebitis being a cause of pyæmia, is is remarkable how often the former occurs without any contamination of the blood whatever; that is, if we can call that phlebitis where we find a vein and its branches quite closed by coagulum or adherent fibrin" (Wilks). Moreover, "it is a question whether, in those cases in which the veins are plugged or inflamed, thrombosis and phlebitis are not the local, and pyæmia the general effect of the same cause" (Savory)—that is, blood infection. With these views I cordially agree.

That blood poisoning may take place through veins is certain, although, as I have already shown, inflammation of their coats does not necessarily lead to it; neither is it probable that the absorption of pus, as pus, is the usual cause; for when pus mixes with blood, coagulation is produced, and thus its circulation is prevented. There seems, however, good reason to believe that the fluid portion of pus or of some decomposing inflammatory product may be taken up by the veins and carried into the system, and thus cause pyæmia. The poison may be imported into the general circulation through either a small or large vein, when involved in a suppurating or sloughing tissue; this is a frequent occurrence when the vein is connected with an inflamed or divided bone.

It may, therefore, be fairly inferred that the *milder forms* of *blood poisoning*, such as traumatic fever, are caused by the circulation of morbid elements in the blood, which are generated either within the body or imported into it from without; and that these morbid elements are at times carried off, sometimes by the lungs and at other times by the intestines: that the *more severe forms of blood poisoning*, as pyæmia, are caused by embolism, thrombosis, or blood extravasation, due to the admixture with the blood of some morbid fluid; and that this morbid material originates the changes which give rise to the secondary or metastatic abscesses with which surgeons and pathologists are so familiar. This view receives much support from the fact, that disintegrating fibrin may be carried from the heart through the arterial system into the smaller vessels of the parenchymatous organs, and give rise not only to constitutional symptoms much akin to those which have been described as being present in pyæmia, but to analogous pathological conditions. This condition is spoken of as arterial pyæmia. Thus in the more common form of pyæmia abscesses form in the viscera or other parts; and in "arterial pyæmia" lobular fibrinous changes occur. In the former case secondary abscesses are found after death, in the latter secondary fibrinous deposits; it seems probable also that at times these fibrinous deposits may break down and give rise to abscesses.

This arterial pyæmia is met with after ulcerative and rheumatic endocarditis; it is, doubtless, the cause of the so-called rheumatic pains that follow scarlet fever; and in rarer instances it gives rise to the embolic plugging of some large vessel, which may be followed by gangrene, or by the formation of an aneurism. I have had to remove a leg on two occasions for gangrene from embolism of the femoral artery after scarlet fever, and have seen cases of aneurism which have probably been due to the same cause. (Vide 'Path. Soc. Trans.,' 1877.)

Arterial pyæmia is not necessarily fatal. Mild attacks come and go, says Wilks, "the proof being found eventually in the cicatrices and remnants of deposits met with in the organs of the bodies of those who have died of heart disease." The mild forms manifest themselves by pyrexia, prostration, and pains in the joints.

Hence, when a patient dies rapidly from blood poisoning, the only pathological change found in the tissues may be some lobular congestion of the lung, indicating the first stage of pneumonia; when life has lasted longer, red or gray hepatization may be present; and in a later stage lobular suppuration; these different conditions depending upon the intensity of the disease and its duration. "The first stage of the morbid condition which is produced in the viscera is a coagulation in the vessels, and the last stage is suppuration." (Wilks.)

In feeble patients who have no resisting power against disease, it is possible that even these pathological conditions may not be found; life being, as it were, suddenly destroyed in the first onset of the blood poisoning. Under these circumstances no definite post-mortem appearances would be seen, beyond, perhaps, a general softening of the viscera, or some purpuric condition.

Duration of the disease.—There seems reason to believe that a patient may die in two or three days after the first appearance of the symptoms, and, as a rule, bad cases terminate during the second week. Others go on for six or seven weeks. The longer a patient lives the greater the hopes of a successful issue.

Prognosis.—In every case of blood poisoning great cause for anxiety exists, it being impossible to foretell its course or its end. In one case, a small dose of the poison will prove fatal, while in another a full dose will be thrown off. The violence of the attack does not depend upon the severity or size of the wound; for a trifling wound is at times followed by urgent symptoms, while a severe local injury may be followed by but few, if any, complications. Indeed, some of the severest cases of blood poisoning are found in those in whom there is no wound.

A robust person, doubtless, has a better chance of recovery than a feeble, and an abstemious one than a drunkard. Where diseased viscera exist, particularly diseased kidneys, the prospects of recovery are small indeed, the capabilities of a patient to resist any diseased action under these circumstances being slight in the extreme. A single attack of traumatic fever may pass off without trouble, but a relapse or a second attack always indicates serious mischief. Rigors rarely occur without suggesting the presence of some secondary deposit or local inflammation. One rigor may pass off and leave no trace of harm behind, but a succession of them is associated too frequently with the gravest local complications, such as secondary metastatic abscesses. These abscesses also when they occur outside any of the three great cavities of the body are less dangerous than when they occur in the viscera. Acute pyæmia is always accompanied with great danger; but when the disease is chronic there is always more hope.

The occurrence of pyæmia in different classes of cases is well shown in the following tables:

Analysis of the 217 *cases of Pyæmia.*

Of 217 cases—
68 or 31·3 per cent. were after compound fractures as a whole.
24 or 11· per cent. not amputated.
44 " 20·2 " amputated.
26 " 12· " were after amputation for disease.
28 " 12·9 " " after other operations.
21 " 9·6 " " after injury without operation.
60 " 27·6 " " after disease without operation.
12 " 5·5 " " idiopathic. 2·9 per cent. puerperal.

Through the kindness of Dr. Steele, who has aided me in this statistical investigation, I am able also to give the following interesting facts respecting pyæmia.

Out of 790 cases of compound fracture, 192 died, or 24· per cent.
68 of pyæmia, or 8·6 per cent.
Of 184 cases treated by amputation—
89 died, or 47·7 per cent.
44 of pyæmia, or 23·9 per cent.
Of 606 treated without amputation—
103 died, or 17· per cent.
24 of pyæmia, or 3·9 per cent.
Out of 324 cases of amputation of thigh, leg, arm, and forearm for disease—
126 died, or 38·8 per cent.
26 of pyæmia, or 8· per cent.
Pyæmia is thus seen to be three times as fatal after amputation for compound fracture as for disease.
Out of 29,434 surgical cases admitted into Guy's during 10 years, there were 1749 deaths, or 5·9 per cent.
203 of these were from pyæmia, or 11·6 per cent. of the fatal cases; about one in nine of the deaths arising from this cause.
But of the whole number of cases treated, pyæmia was fatal in one case out of about 150, not two-thirds per cent.

But is pyæmia a hospital disease? Does it arise from causes that are generated in a hospital? or is it met with more frequently in a hospital because the class of cases in which it is most prone to occur are there treated? Is it found in private practice?

As an answer to the last question it is only necessary for me to refer to Mr. Prescott Hewett's presidential address at the Clinical Society in 1874, in which he gave the particulars of twenty-three examples of pyæmia occurring in private practice, and in six only after operations, four being very trivial operations.

Sixteen of these were in town and seven in the country, and all were placed under most favorable circumstances.

We know, moreover, that some of the worst cases of pyæmia that are seen in the London hospitals—and I can answer for Guy's—are admitted with the affection.

Under these circumstances it may confidently be asserted, that what is known as pyæmia is not peculiarly a hospital disease, and that it probably occurs after surgical injuries and operations as frequently in private as in hospital practice. It is true that pyæmia often takes its origin in hospitals, but equally true is it that it does so because the class of cases in which the affection is the most prone to occur are there to be found.

Blood poisoning may occur anywhere, in hospitals or in private houses; but it is unfair and unscientific to attribute it without reason or evidence to what has been so wrongly described as "Hospitalism."

TREATMENT.—An unlimited supply of fresh air, simple nutritious food, and, where a wound or suppuration exists, the most thorough *cleanliness*, are the main points of practice to be attended to in the treatment of every case of traumatic fever or pyæmia. Compared with these, all other means are of secondary importance.

As the disease is due to a blood poison, often taken into the body from without, it is the surgeon's duty to see that the patient's room is well ventilated, that it is neither too hot nor too cold, as both extremes are powerful depressants; that the air circulating through it is free, fresh, and fragrant; that the room is frequently purified by cleansing and disinfectants, large dishes of any disinfecting fluid and cloths saturated with the same being distributed about; solid iodine exposed in a plate to the air is a good disinfectant, and more persistent than some others. Care must be taken that no poison from a drain or closet reaches the room; and that all excretions are disinfected at once, indeed, passed directly into vessels containing disinfecting fluid, such as Condy's, carbolic acid, chloride of lime, or chloralum. The wound should be kept *clean*, and care should be taken that all discharges are allowed a free escape. Dressings, when employed to a suppurating or sloughing wound, should be saturated with disinfecting lotions, and changed every three or four hours. When possible, foul wounds should be irrigated, a stream of warm water containing a disinfectant being allowed to run over the surface. I know of no means so valuable for keeping a wound clean as this. When sloughing of the part is present, charcoal poultices are at times beneficial. Sponges should never be employed where pus exists, but tow or cotton-wool, more particularly the absorbing cotton-wool known as Brun's; or camel's hair pencils kept in a lotion of carbolic acid, as suggested by Callender. Poultices, when employed, may be put on tow or oakum, both of which materials, through the tar they contain, being disinfectants.

In simple, *uncomplicated traumatic fever*, when it stops within the ordinary bounds, and neither runs on nor returns in its severity, no special treatment is called for. Should restlessness or much pain exist, a sedative dose of chloral, opium, or morphia may be given, either by the mouth, rectum, or skin, and beyond this nothing is needed. In more confirmed cases of suppurative fever, when systemic infection is declared, the vital energies of the patient must be maintained or stimulated, and everything that tends to lower must be warded off; thus the administration of tonic medicine becomes a necessity, the preparations of iron being the best, but strychnine and quinine are likewise of great use. Some surgeons employ very large doses of quinine, and speak highly of it—from ten to twenty grains being given at the first onset of pyæmia, and repeated every three or four hours—and Dr. Goodhart's investigations ('Guy's Hosp. Rep.,' 1870) seem to show that quinine in full doses helps defervescence. Stimulants must be administered with caution, and their amount regulated by the wants of the individual case. When the patient's habits have been free, alcohol in some of its forms will be required, even in large quantities; whereas to an abstemious person a very moderate dose will be sufficient, a large one doing harm; and that form of stimulant is apparently the best to which the patient has been accustomed.

The diet should be as nutritious as possible, but its nature must depend upon the assimilative powers of the stomach. Where milk agrees, no better drink can be given, either alone or mixed with eggs or some spirit; cream may be added at times, or the concentrated Swiss milk; animal broths may likewise be freely used. When meat can be digested it may be given, although sparingly. When a patient refuses food, Liebig's extract of meat, or Darby's fluid meat, may be mixed with the beer or wine without his knowledge. When the stomach rejects nourishment it must be given by the rectum, an enema of beef-tea and egg being administered every four or six hours. Ice may always be allowed in small quantities, as it gives comfort. When the nervous system is disturbed from want of sleep or otherwise, opium may be given, small doses frequently repeated being better than large. Where enemata are used, laudanum may be mixed with them.

Should diarrhœa exist it must not be checked too suddenly, for in some cases of blood poisoning it appears to have an eliminative tendency; it should be stopped only when telling on the patient's powers. To give remedies, however, with the view of eliminating the poison by the bowel is a rash practice, and cannot be recommended. The sulphites and chlorides in any of their forms do not appear to have any power to neutralize the poison in the blood; they have been, however, highly praised. The alkaline salts have likewise been strongly recommended "to promote the changing and eliminating of the products of the retrograde metamorphosis of the tissues" (Savory). Of these the carbonate of ammonia is probably the best, either given alone or with the liquid extract of bark.

When secondary abscesses have formed in the cellular tissue and between the muscles they should be opened; but great caution must be observed in dealing with inflamed joints. When the presence of pus can be clearly made out, it should be evacuated by a free incision into the joint, and care taken that it does not re-accumulate; when possible a drainage tube should be introduced into the cavity, and the joint daily freely washed out with a stream of warm water colored with Condy's, or some other disinfecting fluid, such as carbolic acid, one part in forty, or iodine water composed of one drachm of the tincture of iodine to a pint of water. Soothing applications should at the same time be employed, poppy fomentations being probably the best.

When acute blood poisoning has set in, it is almost needless to say that amputation of a diseased limb has no influence in checking the disease, nor has the application of caustics or cauteries to a wound; indeed, no local treatment is known by which the formation of secondary abscesses can be prevented. In chronic pyæmia, however, amputation is often of essential service.

How far blood poisoning can be prevented is another question, and as it is an important one it may be considered here.

As to the exciting cause of the disease nothing is known. It attacks the healthy as well as the cachectic; those surrounded by perfect hygienic influences, as well as those subjected to the most unfavorable, and it is found in private as well as in public practice. It is true that the cachectic, and those who are subjected to close and unhealthy atmospheres, are the more prone to its attack, and that overcrowding in small wards, bad ventilation, bad drainage, and bad feeding, with every other influence that has a depressing action on the vital powers, are known to have an injurious tendency. It becomes the surgeon's duty, therefore, to ward off, as far as he can, all such influences. In cases for operation, when time is allowed for preparation, the general condition of the patient should be investigated; care should be taken that the excretory glands are performing their functions, and, if not, they should, if possible, be at once corrected. The feeble must be strengthened by tonics and good nutritious food, and the supply of stimulants should be regulated in all. The intemperate man should be brought to see the necessity for moderation, and to know that life cannot long be sustained by drink alone; he must learn also that stimulants are chiefly of value in assisting digestion and the assimilation of nutritious food. The urine under all circumstances should be examined for albumen; for although its presence would not deter the surgeon from performing an operation of necessity, to save life, it would affect his prognosis, and would most certainly influence his decision in an operation of expediency. All patients after operation should be kept in absolute repose, the wounds kept clean, and lightly dressed. Everything that tends to procure rapid union must be considered good, and all that induces or keeps up suppuration bad, blood poisoning and suppuration, whether with or without a wound, having a close connection. No one who has been in contact with any infectious disorder, such as erysipelas or scarlet fever, should be allowed to come near the patient; for there can be no doubt that there is some subtle connection between these poisons and pyæmia. And, lastly, every cheering influence should be brought to bear on the mind of the patient, as well as on his surroundings; for among the agents predisposing to blood poisoning, mental anxieties and depressing emotions should doubtless be reckoned.

HECTIC FEVER.

There can be little doubt that surgeons of former times included under the above heading many cases of what we now call septicæmia, pyæmia, or blood poisoning; and even at the present time it is an open point as to how far the symptoms which denote hectic fever are due to the absorption of some foreign element into the blood.

That hectic fever is never found except in those who are the victims of destructive organic changes, chiefly of a suppurative nature, is an established fact; and it is in such also that confirmed blood poisoning generally occurs. The physician meets with this condition in pneumonia, phthisis, empyema, abscess in the liver, kidneys, or ovary; the surgeon in suppurative diseases of joints and bones, in spinal disease, compound fractures, diffused suppurations, etc. In all classes of cases there is a destructive wasting and influence at work, undermining the patient's powers and producing general emaciation. The characteristic symptoms are of a remittent character, and usually appear at least once daily, generally towards evening, but they may occur more frequently. They are not unlike those of ague.

A paroxysm of hectic may be said to commence with fever, of more or less intensity;

the skin will be hot and dry, the pulse rapid and feeble. The face, too, will be flushed in a single patch, and the palms of the hands and the soles of the feet hot and burning. The tongue during the paroxysm may be dry, and great thirst present. There will, however, be no brain symptoms, no clouding of the intellect, no delirium. The febrile condition may be preceded by shivering or chilliness, but such symptoms are unusual, and are always followed by *a profuse and exhaustive sweat*. This sweating is indeed peculiar to the affection, for it bears no proportion to the febrile symptoms that preceded it. At the commencement of the disease the febrility may be so slight as hardly to be noticed, and yet the patient on falling to sleep and awakening will be bathed in perspiration. When the disease is at its height the cold, hot, and sweating stages may be easily seen; but when it declines the febrile symptoms will be constant, although aggravated towards night, while the morning "colliquative" sweats gradually become more profuse as life ebbs away.

In the early stage of this disease, *between* the paroxysms, there may be no fever. The tongue, dry during the attack, will be moist and clean, but, towards the close, becomes morbidly red, smooth, and sore, with aphthous ulceration. The appetite and digestive organs are rarely much affected; indeed, they are little altered till the general powers are failing rapidly. The skin, at first supple and moist between the attacks, becomes as the disease progresses harsh, dry, and covered with branny scales. The urine, always scanty and high colored, is more so towards the close of the disease. The bowels are sometimes constipated, but more frequently loose. Throughout the disease, however, the mental faculties remain unimpaired, even when the bodily powers are reduced to a minimum. During the whole disease sleep is usually obtained between the attacks. Death always ensues from exhaustion, and bed-sores too frequently form, adding to the sufferings of the patient.

TREATMENT.—The removal of the cause of the disease is the only means by which a cure can be effected. As the affection is one purely of exhaustion, the object must be to maintain the strength of the patient in every way by the administration of abundance of simple nutritious food, with stimulants carefully adjusted to the special wants of the case. The former should be given at certain short intervals in small quantities, and the latter in sufficient quantities to aid digestion.

Tonic medicine should always be given, quinine probably being the best, as this drug has, doubtless, a power in checking febrile action, in keeping down the temperature of the body, and in preventing sweats. It should be given in a full dose, five grains in the solid form, before the paroxysm. Iron and strychnine are also valuable drugs, and the extract of belladonna in doses of half a grain or more combined with the tonic is of great value. Diarrhœa, when present, should be checked by astringents, but opium should be sparingly employed, except to relieve pain.

With respect to the removal of the cause of the disease by operation when such is possible, there can be no difference of opinion among surgeons; for hectic is a proof that nature's reparative powers have been found wanting in their efforts to cure the local affection, and under these circumstances the surgeon's duty doubtless lies in operative interference. If the disease can be removed, this should be done, and delay is almost criminal. Let the source of irritation, or weakness, be removed, and it is wonderful how rapidly the most feeble subject may rally after the operation. If the viscera are sound, good hopes of a recovery may be entertained under apparently the most adverse conditions; but if the kidneys are diseased, the prospects of recovery are feeble.

Moxon, 'Guy's Hosp. Reports,' 1871.—*Wilks*, 'Guy's Hosp. Reports' for 1861 and 1870.—*Lee*, "On Phlebitis," 'Practical Pathology.'—*Paget and Savory*, 'St. Bart. Reports,' vols. i and ii, 1865–6.—*Virchow*, 'Cellular Pathology.'—*Pick*, 'St. George's Hosp. Reports,' vol. iii.—*Billroth, Dr. Th.*, 'Archiv für Klin. Chirurgie' (Langenbeck's), B. ii, vi, viii, ix.—*Bristowe*, 'Trans. Path. Soc. Lond.' vol. xiii.—Reynolds's 'System of Medicine.'—*Roser*, 'Sydenham Soc. Year-Book,' 1863, p. 192.—*Prof. O. Weber*, 'Berl. Klin. Wochenschr.,' 1864. 'Year-Book,' 1864, p. 227.—*Gibson*, 'Brit. and For. Med.-Chir. Rev.,' Jan., 1866.—*Callender*, Holmes's 'Syst. of Surg.,' 2d edit., vol. i.—*Sédillot*, 'On Pyæmia,' 1849.—*Arnott*, 'Med.-Chir. Trans.,' vol. xv.—*Braidwood*, 'On Pyæmia,' 1865.—*Griesinger*, "On Leukæmia and Pyæmia," Discussion at Clin. Soc., 1874.

CHAPTER II.

ON ANIMAL POISONS.

POISONED WOUNDS.

UNDER this heading, Dissection wounds, wounds from the sting or bite of healthy insects and animals, and wounds from the bite of diseased animals, or inoculation from their blood, will be considered.

Dissection Wounds.—These are of frequent occurrence, although it is exceptional to find them followed by any seriously ill effects. In common with all wounds, they may be attended with absorbent inflammation, inflammation of the cellular tissue, suppuration, septicæmia, or pyæmia; and feeble or cachectic subjects are more liable to any one of these consequences than the strong and steady.

In exceptional instances, however, different results follow, and two forms of the affection may be recognized—the *mild* and the *acute*.

"The symptoms in the *mild* form partake," say Poland, "more or less of the ordinary character of non-specific inflammation, and scarcely present any noticeable characteristic signs; thus, the local appearances consist in the puncture assuming a defined red aspect, which soon becomes pustular; this bursts, and ends in an unhealthy suppuration; there is surrounding erythema of an erratic form, and inflammation and pain extending along the forearm and arm to the axilla, ending in the enlargement and suppuration of the glands. The constitutional effects consist in febrile disturbance, loss of appetite, diarrhœa, fetid eructations, &c. The prognosis and termination are favorable; and the treatment required is to be based upon general principles. The symptoms of the *acute* or severe forms are those of a truly specific disease; the local signs commence by the appearance of a small circular or oval vesicle over the seat of puncture, which soon becomes turbid, milky, and pustular, and not unfrequently has a defined margin, resembling somewhat that of smallpox. This is generally unattended with pain; but the patient often complains of intense pain in the shoulder and about the axilla, which shoots down the chest. The glands in the axilla are early affected, and seem to act as barriers to the further progress of the poison; they become enlarged, and the surrounding cellular tissue is implicated, with serous effusion; there is erythema and puffy swelling; these extend to the subscapular and pectoral regions, spreading down the side of the chest, yielding to pressure, and imparting a peculiar spongy feel. There is, besides, an œdematous and doughy condition of the arm and forearm, owing to serous exudation into the cellular tissue, which seldom, if ever, passes into suppuration."

"The constitutional symptoms are at first those of strong excitement; but these are soon followed by those of extreme depression of spirits and much suffering. Rigors, headache, prostration of strength, vomiting, &c., supervene; and, lastly, all the symptoms of low typhoid fever rapidly set in."

In some cases the absorbent glands are not involved, and death may occur from prostration in the early stage of the disease; in others, suppuration and pyæmia may appear, while in a third extensive and diffused sloughing of the skin may ensue—all these points being materially influenced by the power of the patient to throw off morbific influences.

The *prognosis* in these acute cases must be unfavorable. Travers calculated that one in seven recovers; probably this is rather in excess of experience; but if the patient does not sink during the violence of the attack, his powers will be tried to the utmost by the protracted suppuration.

The inoculation from a recently dead body is more serious than that from an old subject of the dissecting-room, and the fluids from a patient who has died from glanders, peritonitis, and scarlet or puerperal fever, are far more dangerous than all others. There is reason, indeed, to believe that the contact with such fluids is capable of giving rise to the disease without any local wound or abrasion.

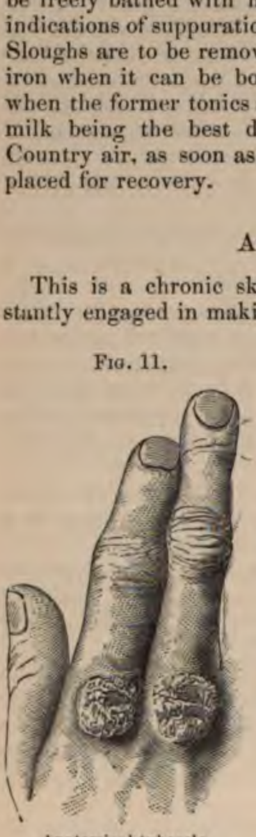
TREATMENT.—To keep the patient alive and to treat on general principles any local symptoms as they arise is the usual method now pursued.

A student when he pricks his finger should at once clean and suck the wound, and at the same time arrest the circulation of blood through it for at least a minute, by pressure applied with the opposite hand on its cardiac side. The part may then be closed over, a piece of gutta-percha skin made adherent with chloroform being an admirable application. When the wound is free and the poison is from a recent puerperal or allied case, some caustic such as the nitrate of silver, chloride of zinc, or even nitric acid may be applied. The first two are probably the best. When any inflammation appears, a poultice should be applied, and the hand raised above the shoulder, and, if there should be any tension of the part, it is to be at once relieved by an incision.

Absorbent or cellular inflammation should be treated by fomentations. Some surgeons have faith in the local application of nitrate of silver, iodine, or the solution of the perchloride of iron as a means for arresting its progress. The glands when enlarged should be freely bathed with hot water, and hot fomentations constantly applied. The earliest indications of suppuration ought to be looked for in order that pus may be at once evacuated. Sloughs are to be removed by moderate incisions. Tonics should be given from the first, iron when it can be borne with or without quinine in full doses, or ammonia and bark when the former tonics are inapplicable. Nutritious food ought to be given in abundance, milk being the best drink; stimulants, too, when needed, but always with caution. Country air, as soon as it can be enjoyed, is the great aid upon which reliance may be placed for recovery.

ANATOMICAL OR PATHOLOGICAL TUBERCLE.

FIG. 11.



Anatomical tubercle. Model Guy's Mus. 193^{80}.

This is a chronic skin affection, which is to be met with on the hands of those constantly engaged in making post-mortem examinations. Dr. Wilks, when describing some models of the affection that are to be seen in Guy's museum (Fig. 11), called it "*verruca necrogenica*" ('Guy's Rep.,' 1862). In its early stage it is not unlike epithelial cancer. "It commences without any evident breach of surface, the parts affected being not those liable to pustules, as the back of the hand or wrist, but the knuckles and joints of the fingers. If the disease should begin with a pustule, the pustule bursts, but instead of healing, a thickening of the cuticle takes place around it, and as from time to time a little fresh suppuration occurs, so the thickening and induration increase. Generally, however, these changes go on slowly, without any preliminary vesication. A warty thickening of the epithelium takes place, which, in course of time, becomes of a dark color, until a kind of ichthyotic condition is produced."

The disease is local, and unattended by constitutional symptoms. The repeated application of the strong tincture of iodine, acid nitrate of mercury, or nitric acid, will effect a cure.

Insect stings in this country are not very severe, and, unless inflicted in large numbers, are rarely brought under the notice of the surgeon. Slight fever and constitutional disturbance may follow them in some children who are susceptible to external influences, whilst local swelling, heat, and redness are very marked in others. Should a wasp or bee accidentally be taken into the mouth with fruit, and the base of the tongue, pharynx, or larynx stung, serious symptoms may appear by the œdema and swelling of the parts impeding respiration. When this accident happens, scarifications should be employed with fomentations, but if life be threatened, the windpipe must be opened.

When the tongue or other accessible part is affected, the sting should be removed, if possible, with a pair of fine forceps, and thus much pain is saved. Where this cannot be done, a drop of either the liquor ammoniæ, sal volatile, or oil of lavender, applied to the part generally gives relief. The parts should also be protected from the air by collodion, flour, chalk, or strapping.

The bite of the scorpion, the tarantula, and other tropical insects is, however, more troublesome, and is often followed by nervous depression, vomiting, and local pain. In South America, the mosquito bite is at times attended with severe local inflammation, and sometimes with ulceration. In Africa and Asia, the scorpion, which is from six to ten inches long, is so venomous as to cause, by its bite, at times, loss of life. Olive oil is the usual application for the wound, but liquor ammoniæ is probably better. Brandy and ammonia should be given internally when great depression exists.

The bite of the spider is very similar in its effects to that of the scorpion, though the wonderful stories as to its poisonous qualities are now regarded as fabulous.

Serpent bites are often serious, and at times fatal, the poison being squeezed into the tissue in the act of biting, from a special apparatus situated at the base of the upper fangs. In England, the *viper* is the only poisonous reptile, and although some local and constitutional disturbance may follow its bite, a fatal result rarely ensues.

The *cobra di capello*, *rattlesnake*, *whipcord snake*, and *phoorsa snake* are the most venomous.

In some cases the poison seems to spend its effects upon the nervous system, killing by convulsions or coma; in others, its local effects are the more important.

Dr. S. Weir Mitchell, of Philadelphia, who has carefully studied the effects of poison by the rattlesnake, states that the bite is sometimes followed by pain of a pricking or burning character, which gradually becomes more intense, also by bleeding, swelling, and discoloration of the injured part and tissues around, these symptoms depending upon the effusion of blood into the cellular tissue. The wounded extremity becomes larger and the pain greater, the skin assuming a mottled marbly aspect. As secondary effects, inflammation and disorganization of the tissues occur; the inflammation assumes more the character of the phlegmonous erysipelas, and is associated with glandular enlargement and suppuration, followed by gangrene as a common consequence.

Great depression of the nervous system and general prostration are the most prominent constitutional symptoms, with profuse cold sweats, vomiting, dyspnœa, and diarrhœa; and jaundice often precedes death.

When the dose of the poison is large, or the susceptibilities of the patient acute, death may take place at once from general prostration and local stagnation of blood in the wounded extremity. In the case of a keeper of the London Zoological Gardens, who was bitten in the nose by a cobra, death took place in little more than an hour after the infliction of the wound, and half an hour only had elapsed when he was apparently dying, being unable to speak, swallow, or support himself; the pupils became dilated, the face livid, the heart's action feeble, and he was scarcely conscious.

Mitchell has recorded a case which proved fatal in five and a half hours. Of others one died comatose, another with dyspnœa and dysphagia, a third felt sleepy and died without agony.

On the other hand, patients at times recover suddenly, even when the symptoms have been severe, as if the poison had suddenly lost its power. More commonly, however, death ensues, and when recovery follows, it is only after severe local suppuration and sloughing, leaving a maimed and useless limb.

After death Mitchell found ecchymoses in the thoracic and abdominal viscera, the spots containing blood-cells, this exudation being purpuric in its nature, and clearly caused by a want of the normal coagulating power in the blood; this altered condition of the blood indeed is the most common effect of snake poisons, and in some cases it is said to last through life. Hence, in bites from the Indian phoorsa snake, there is said to be a hemorrhagic tendency during life. After death Mitchell could never detect the least alteration in the blood-cells in acute cases, but in exceptional examples of chronic poisoning he found a few globules indented. In chronic cases also, where there has been time for the poison to act upon the blood, the want of coagulating power in the blood is very constant, and putrefactive changes rapidly follow.

Dr. Halford, of Melbourne, says he always found the blood after death dark and fluid. It also contained germinal nucleated cells, which he regards as molecules of living foreign matter thrown into the blood from the venom, and he accounts for the asphyxia and death by the increase and multiplication of these molecules, which takes place at the expense of the oxygen normally wanted in inspiration.

Sir J. Fayrer tells us, however, that he has never been able to detect these changes in the blood, although the poison affects the blood primarily, and the nervous centres indirectly through it. ('Indian Annals of Med. Science,' 1870.)

TREATMENT should be most energetic, otherwise the depressing influence of the poison will soon paralyze all action, a few seconds often being enough for the absorption of the poison.

Locally, the aim should be to arrest the absorption of the poison by fastening a ligature firmly on the cardiac side of the wound, by excising the wounded part, and by the application of nitric acid, carbolic acid, or the nitrate of silver.

Fayrer records, that the natives of India apply a ligature not only just above the bite, but at several places on the limb at intervals of some inches; they then place a red-hot coal upon the wounded part. The danger and difficulty lie in not applying the ligature quickly enough. The ligature must also be tightened to the utmost, till the circulation is entirely arrested and the part is livid with retained blood. The punctures should then be scarified to allow the blood to flow freely, and the cautery or caustics afterwards be applied.

Constitutionally, the best treatment lies in the administration of ammonia and stimulants in sufficient quantities to maintain the action of the nervous and circulatory systems, and thus to keep the patient alive whilst the poison is being worked off or becomes exhausted; for the man who is dying from snake bite is perishing from rapid exhaustion of nerve force. Any other measure that can rouse and stimulate the failing nervous energy may also be employed.

Fowler's solution in full doses every half hour for four hours is said to have been useful. Iodine has also been advocated, and olive oil internally in full doses has been highly praised. In countries where poisonous snakes abound, different roots have their reputation, such as the guaco, the sacræ vitæ ancora, radix corineæ, decoction of Virginia snakeroot, &c. &c.; but Fayrer, after repeated experiments, believes them to be utterly useless.

Halford has inferred from his experiments that the injection of twenty to thirty drops of a solution of one part of strong liquor ammoniæ to three parts by measure of water into one of the veins of the wounded limb, accompanied by the local application of liquor ammoniæ to the part, is a specific; but Fayrer, who has tried the practice, has failed to find the success looked for. Mitchell advises ligature on the cardiac side of the wound; or excision, amputation, or destruction by cautery or escharotics of the poisoned part; and even *suction* of the wound immediately after the bite, as the poison has no influence in the stomach. He thinks well also of the injection into the wound of iodine or ammonia, and says the natives believe the local application of olive oil to be the best. Together with this local treatment, the patient is to be kept up by hope, the action of the heart sustained by stimulants quite irrespective of quantity, and the general powers maintained by nutritious food. By these means, "if the person be not thoroughly poisoned, we may help him to recover. If he be badly bitten by one of the more deadly snakes, we can do no more." (Fayrer.)

Bites of Diseased Animals.

Hydrophobia, meaning the "dread of water;" which is more correctly termed "RABIES," is a disease contracted from a rabid animal, generally from its bite through its saliva or mucus. It appears at all seasons of the year, and is always fatal.

It is more common in temperate regions of the world than in the torrid and frigid zones. It is unknown in Australia, New Zealand, Greenland, and Kamschatka.

Blaine and Youatt affirm that in animals, rabies is entirely due to a traumatic action, viz., the bite of some rabid creature inflicted on another previously free from the disease. Fleming, the most recent authority, tells us, however, that the virus of rabies may, under certain favorable conditions, be generated directly without the intervention of any infecting medium, although at present we are in complete ignorance of the conditions on which its spontaneous production depends. All animals bitten do not contract the disease, as is proved by Renault, of Alfort, who caused dogs, horses, &c., to be bitten several times, and even inoculated them, when out of 99 cases, 67 contracted the malady, and 32, or one-third, escaped. Fleming calculates that 30 or 40 per cent. of people who are bitten by mad animals go mad.

In the *dog* there are three well-marked stages of the complaint. The *first* is the *melancholic*, characterized by melancholy, depression, sullenness, and fidgetiness; the *second*, the *furious*, by excitement, or rabid fury; and the *last*, the *paralytic*, by general muscular debility and actual *paralysis*.

"The dog," writes Trousseau, "looks ill and sullen after a period of incubation of very variable length; he is constantly agitated, turning round and round inside his kennel, or roaming about if he is at large. His eyes, when turned on his master, have a strange look in them, expressive of sadness as well as of distrust. His attitude is suspicious, and indicates that he is not well; by his wandering 'he seems to be seeking' for a remedy. He is not to be trusted; if he obeys at all, he does it slowly; but if you chastise him he may, in spite of himself, inflict a fatal bite." "His agitation increases; if in a room, he runs about looking under the furniture, tearing the curtains and carpets, sometimes flying at the walls, at others jumping as if to catch flies; the next moment he stops, stretches his neck, and seems to listen to a distant noise. He probably has then hallucinations of sight and hearing."

"This delirium," says Youatt, "may still be dispersed by the magical influence of his master's voice; all these dreadful objects may vanish, and the creature creeps to his master with the expression of attachment peculiar to him."

"There follows then an interval of calm; he slowly closes his eyes, hangs down his head, his fore legs seem to give way beneath him, and he looks on the point of dropping. Suddenly, however, he gets up again; fresh phantoms rise before him; he looks around him with a savage expression, and rushes against an enemy which only existed in his imagination. By this time the animal's bark is hoarse and muffled; loud at first, it gradually fails in force and intensity, and becomes weaker and weaker. In some cases the power of barking is completely lost; the dog is dumb, and his tongue hangs out through his half-opened jaws, from which dribbles a frothy saliva. Sometimes his mouth is perfectly dry, and he cannot swallow, although in the majority of cases he can still eat and drink. When he cannot drink, he will lap fluids with great rapidity, but on looking closely it will be seen that he merely bites the water. He can still, in some cases, swallow solids, and he may then swallow anything that is within his reach, bits of wood, pieces of earth, straw, &c."

"Towards the close of the second stage of rabid fury the dog often breaks his chain and runs away; he wanders about the fields, being seized from time to time with paroxysms of fury, and then he stops, from fatigue, as it were, and remains hours in a somnolent state. He generally dies in a ditch or retired corner, apparently from hunger, thirst, and fatigue."

Veterinary surgeons do not say that he dies from asphyxia, brought on by spasm of the pectoral muscles or by convulsions. The disease runs its course in from five to eight days, and it is the same in the dog, cat, horse, and wolf, from any of which man may become inoculated.

In man the disease may show itself at any period from six weeks to a year after the inoculation, although Fleming and Bouley assert that the incubatory period in man varies from one to two months, and that after the third month the chances of immunity are great. Thamhayn ('Schmidt's Jahrbuch.,' 1859), in an analysis of 220 cases showed, that in 49 the symptoms appeared within a month, in 98 during the second, in 29 during the third, and in 26 during the fourth month; 16 of the remaining cases showing themselves within twenty-six months; two cases only maturing at a period of four and five and a half years respectively. But these cases are always doubtful, and are probably examples of hysterical or *nervous hydrophobia*. Fleming, however, records some striking cases which seem to show, that the latent disease may be induced or brought into activity by mental agitation ('Rabies and Hydrophobia,' 1872).

The disease may attack the infant at the breast or the aged, the male or the female, and during the incubative stage no disturbance of the general health can be observed. Van Swieten has pointed out that during this period such a disease as variola may run its course without any modification, two poisons thus coexisting in the same frame.

After the incubative stage has passed, the *first symptom* usually displayed is that ot sadness; the victim either not suspecting his complaint, or carefully avoiding mentioning the circumstance. His sleep is disturbed; he is fidgety, sighs deeply, and avoids society; he is troubled by noise; or is very irritable and ill-tempered. The *second stage* will be marked by an aggravation of all these symptoms, but there will be in addition pain in the region of the heart with some irregularity of the pulse. Rigors will soon appear, which, says Trousseau, "are true convulsions of all the muscles of the body;" and lastly, the characteristic symptom of dread of water, not as fluid, however, but as connected with the difficulty of drinking. The sight of water is frequently sufficient to bring on shuddering, yet it is when the patient carries water to his lips that he is seized with the typical terrors. A rabid man is always rational and tries to drink, but the attempt excites terror, and the expression of his inability. His eyes become fixed, features contracted, and his countenance expressive of the deepest anxiety, his limbs shake, and the whole body shivers. The paroxysm lasts a few seconds, then subsides, but only to be renewed on the slightest breath of air touching his body, for *hyperæsthesia* is one of the most marked symptoms of the affection.

During the calm, nausea or even vomiting may appear, and priapism is often a most distressing symptom. Sudden terror of an unknown kind haunts the mind, and imaginary calling of fiends often exists. Dr. Bergerons records a case in which the patient heard the ringing of bells, and saw mice run about over his bed.

In the third and last stage the longing for drink becomes intense, with an increasing inability to take it; the voice becomes hoarse and the mouth full of a frothy fluid. The patient tries to get rid of this by spitting, and then becomes frightened at its results. In some cases he fears that by contact this fluid may propagate the disease. Convulsive seizures increase in frequency and intensity, the spasm of the respiratory muscles threatening life; at last a fatal spasm takes place, and death by asphyxia ensues.

In the dog, death results from paralysis, in man, generally, from asphyxia; in exceptional cases it is due to exhaustion.

This painful affection rarely lasts longer than four days, though it has been fatal in sixteen hours, and has lasted as long as two or three weeks. Thamhayn shows that 56 out of 202 cases died within forty-two hours, 73 in forty-eight hours, 38 between the second and third days, 19 between the third and fourth days, 7 in five, 5 in six, and 4 in seven days.

The seat of wound or cicatrix rarely shows anything unusual. In three or four cases out of a hundred it may be slightly painful, irritable, or inflamed, or the seat of a neuralgic pain, the pain being a kind of "aura," as in epilepsy; in some instances it is very severe.

Diagnosis.—Taken as a whole, there is no disease like hydrophobia. In a certain sense it resembles tetanus, yet the two, in their general features, are unlike. They may, however, occur together, and so good an observer as Dr. J. W. Ogle has published a case of combined tetanus and hydrophobia in the 'British and Foreign Medico-Chir. Review,' 1868.

What Trousseau has called nervous hydrophobia, true dysphagia, brought on by a dread of rabies, may, however, be mistaken for it; "but the sudden invasion of this complaint generally coming on through the person recalling to mind or hearing the relation of a case of true hydrophobia, and the duration of the dysphagia over the period of four days are amply sufficient to characterize the complaint, and to enable the practitioner to persuade the patient that he is suffering from mere nervous symptoms, which will vanish as soon as he ceases to fear. Besides, in nervous hydrophobia there is dysphagia only, but no general convulsions, the spasm affecting the pharynx alone, while the breathing goes on with regularity."

In the very early period of the disease, during its incubation, Drs. Marochetti, Magistel, Xanthos, and others, have called attention to the presence of pustules or vesicles near the frænum of the tongue, known in Greece as *lyssi*, and they assert, that if these *lyssi* are cauterized, all manifestations of disease can be prevented. Should these observations be confirmed, a valuable means of diagnosis as well as of treatment in the very earliest stage of the disease will have been found. These lyssi are said to show themselves at an earlier period in proportion to the amount of poison deposited in the wound. Marochetti made early incisions through the vesicle, and then cauterized the surface with a red-hot iron, with, he states, invariable success.

Pathology.—There are no pathological lesions peculiar to hydrophobia—at least, none such have as yet been described. Mr. Durham, in a case that occurred at Guy's in 1865, carefully examined the cord, prepared after Dr. L. Clarke's method, and found extreme congestion of the gray matter of the cord, and numerous minute patches of extravasated blood in different sections. More recently Dr. Benedikt, of Vienna, has made out that in dogs "the pathological process in this disease consists in acute exudative inflammation, with hyaloid degeneration, which doubtless arises from the exudative infiltration of the connective tissue of the brain." ('Wiener Mediz. Presse,' June, 1874; 'Lond. Med. Rec.,' Sept. 30, 1874.)

TREATMENT.—In all cases of bites from dogs or animals in which the faintest suspicion of rabies exists, free cauterization with lunar caustic should be performed. Youatt states that he adopted this practice in upwards of 400 cases, and four times on himself, with complete success, and that in all these there was no doubt as to the dog being mad. With such a result no other caustic need be used; when this is not at hand, any acid, caustic alkali, or cautery, will suffice. When the escharotic cannot be obtained the part may be excised, a ligature being fastened beforehand on the cardiac side of the wound. Some surgeons advise amputation.

Mental stimulants, in the way of inspiring hope and removing fear, must be freely administered, and such general treatment as may be needed. No drug has yet been found that has the least influence on the disease, either in preventing or curing it. Dr.

Marochetti's treatment of the lyssi is the only one that can claim any degree of success. How far the constant administration of chloroform would influence the disease is a question that has yet to be put to the proof. To prevent asphyxia from taking place, tracheotomy, as suggested by Dr. Marshall Hall, is a justifiable measure, the operation being based on a good theory, although it has never been performed on the human subject. By it the immediate risk of death from asphyxia would be rendered impossible, and time given for remedies to act or for the disease to run its course. It seems that six or seven days is the utmost period for the disease to be in existence. If life can be prolonged thus far, the hope of a good result may be entertained. Anything that can tend to prevent death, and keep the patient alive, is useful. Tracheotomy is one of these means, and deserves trial, wine and food being valuable adjuvants.

When a dog is known to be mad, it ought to be destroyed; but when any one has been bitten by an animal in which there is no evidence of madness, it should be kept, although apart from others, and guarded, as time will prove the truth of his condition, and do away with the morbid fear of "rabies" that may have been excited by the injury.

GLANDERS.

This is a specific disease given to man by inoculation from the horse. Dr. Elliotson first recognized its true nature, and described it under the term Equinia. It shows itself in two forms. In one the disease attacks the mucous membrane of the nose and the neighboring glands, and is then termed "*glanders.*" In the other it affects the lymphatics of the body generally, giving rise to tumors or a knotty condition of the subcutaneous glands, called "*farcy buds,*" and is therefere called "*farcy.*"

In man, these two forms are generally found together.

There is said to be a stage of incubation varying from two to fifteen days from the inoculation, after which febrile symptoms with excitement appear, followed by the specific eruption. The pains in the limbs accompanying the febrile condition are generally associated with tenderness wherever glands exist, and, on examination, some enlargement of these glands will be found. The eruption is very characteristic, being made up of a crop of vesicles, which become pustular, and are very hard, resembling those of variola more than anything else. They are arranged in groups, with inflamed bases, the face, neck, and abdomen being, as a rule, more covered than the extremities; when close together, they become confluent. These pustules, with their indurated bases, then soften down, leaving ulcerated excavated surfaces. They affect the mucous lining of the nose, giving rise to the discharge. Virchow says that "these so-called pustules are really due to the presence of a tenacious deposit in the corium of the skin, which has much resemblance to tubercle, and microscopically is made up of an amorphous granular appearance mixed with cell-elements, cell-growths, and fat-globules." ('Handbuch.') This opinion is supported by the clinical fact that tubercles in farcy are so often found in the subcutaneous tissue, appearing as hard circumscribed blind boils, or swellings, more or less diffused. These soften down, giving rise to extensive sloughing of the skin and surrounding parts, and are rarely absorbed. During the progress of the disease, soft tumors, not unlike pyæmic cutaneous abscesses, appear about the body, sometimes attacking deeper parts. In the more advanced stages of the disease, these tubercles or so-called pustules attack the larynx and whole respiratory tract, and more particularly the lungs, giving rise to Virchow's pneumonia of glanders, an affection consisting of a series of tubercles beneath the pleura covering the lungs, surrounded by lobular pneumonic inflammation, as in pyæmia. These tubercles are said to have been found in the testicles, kidneys, pancreas, and joints. When they attack the nose, which they usually do at an early period, often before they appear in other parts, the secretion from the nose is at first catarrhal, thin, and clear, subsequently thick, tenacious, and puriform, often mixed with blood, but in many cases it is altogether absent or not noticed till a later period of the disease. The face and head often swell from œdema, presenting a puffy, erysipelatous, shining surface; the conjunctiva also secretes a thick secretion, gluing the eyelids. The tonsils are frequently involved, and often suppurate. As the disease progresses the swellings and discharge increase, the inflammation around spreads and becomes gangrenous, bullæ appear on the skin, the constitutional symptoms become typhoid, a low delirium sets in, not unlike that from pyæmia, and death ensues from coma and exhaustion. When the glands and absorbents are involved, as in the farcy form, suppuration and sloughing are superadded to those already laid down.

The ***prognosis*** of glanders is most unfavorable, recovery only taking place in the mildest cases of poisoning. The disease in its acutest stage may prove fatal in a week; indeed, it has run its course in three days, but in general it lasts for three or four weeks, and in very chronic cases life has been prolonged for months. In chronic "farcy," where sloughing glands have left large sores, these may remain open for a long time; occasionally such chronic cases end by an attack of acute disease.

The post-mortem appearances have been well described in two recent cases, in both of which there was the absence of nasal discharge. One was Dickinson's case, and the other Poland's, from whose paper, in 'Holmes' Surg.,' vol. i, I quote. The first-mentioned subject died on the twenty-first day. The blood was found fluid, the muscles soft and rotten, the cervical and left parotid glands suppurating, the lower part of the right lung solid with gray hepatization, its tissues completely broken down and infiltrated with purulent fluid, and the left lung studded with numerous slate-colored patches of the size of hazelnuts.

The second patient died on the thirteenth day. There was no affection of the lymphatic glands, but suppuration had taken place in the muscles of both calves of the legs, accompanied by local abscesses in other parts of the body, chiefly in the muscles; the joints were free from suppuration; there were recent patches of lymph on the pleura, and lobular pneumonia in the base of the upper lobe of the right lung, which was in a state of gray hepatization; the lower lobes of both lungs throughout contained smaller hepatized masses; and the liver was free from disease.

Billroth lays great stress on the presence of hemorrhagic abscesses in the muscles as being characteristic of the pyæmia of glanders.

In man, the poison is generally communicated through the nasal discharge from the horse and the discharge from farcy swellings. Where the inoculation takes place from the latter, the disease in man is more of the character of farcy. It can be communicated from man to man. The poison, to be absorbed, requires, as a rule, a wound or delicate membrane, yet cases are on record where the disease has been set up by wiping of the face with unclean hands or cloths.

Youatt states that the disease is not one-tenth part so common as it was, and "generally speaking, it is only found as a frequent and prevalent disease where neglect and filth and want of ventilation exist."

Glanders, writes Dr. G. Milroy ('Trans. Epidem. Soc.,' vol. i), is "a *general* as well as a *propagable* disease; it is extremely apt in some seasons to develop itself in foul, unventilated stables." Its development may, however, be controlled even to absolute prevention by the observance of simple sanitary rules.

TREATMENT.—To keep the machinery of life going, and to treat symptoms upon ordinary surgical principles, seems to be the best mode of practice, for there is no drug which has any influence upon the disease. Abundance of fresh air should be provided, with good but not too stimulating food, accompanied by tonics, such as quinine and iron; pain should be soothed by sedatives. When the nose is a source of trouble, it should be kept clean by washing, a stream of water passed through the nostril, followed by some antiseptic lotion, such as that of iodine, carbolic acid, Condy's fluid, or creasote; nitrate of silver solution, tannic acid, and others more stimulating, being at times valuable. Where the throat is affected, it should be sponged with some nitro-muriatic acid lotion, and a gargle of chlorate of potash used.

Abscesses and softened turbercles should be opened early and freely, poultices and fomentations being applied to the parts. When they are very numerous, this practice is, however, difficult to follow. Perfect cleanliness should, of course, be observed.

Glanders in the horse, as Mr. Youatt tells us, in his book on that animal, is chiefly to be recognized by the persistent *discharge* from the nostril and the singular *hardness* of the submaxillary glands, which become adherent to the bone, from the effusion of inflammatory lymph around them. These glands are not very large except at the commencement of the disease, neither are they hot nor tender.

When any doubt exists as to the nature of the disease, a condemned horse or ass would be inoculated with the nasal secretion of the suspected animal, and if the disease be genuine it will be reproduced in a few days.

Equinia mitis is a local pustular disease affecting the hands and body of those who dress the heels of horses affected with what Jenner has described as the "*grease*"—an inflammation and swelling of the heels of the horse, attended with the secretion of a thin acrid matter. It is not unlike ecthyma or vaccinia, but more angry; the pustules are about the size of a sixpence; they suppurate on the third day, dry up about the tenth or twelfth, forming scabs, which leave cicatrices. The disease runs its course, and is to be managed by rest and cleanliness.

SYPHILIS.

SYPHILIS is a constitutional disease, the result of a specific animal poison introduced from without. Like other specific animal poisons, it is, as a rule, propagated by some local inoculation; but, unlike all others, it has, by its subtle influence through the parents, the power of affecting the unborn fœtus and the newly born child. No other blood poison appears to possess this power, at any rate to the same degree, and it is well to bear this important point of difference in mind, for, in all other respects there is a strong analogy between all.

The poison once introduced into the system, either by inheritance—*inherited syphilis*—or by some local inoculation—*acquired syphilis*—manifests its presence in its own peculiar way, by the appearance of a somewhat irregular although characteristic chain of symptoms. These are uncertain in the period of their manifestation after the inoculation, in the order of their appearance, and in their form and effects, yet they possess their own special features. They are local and general. They run their course, yet do not eliminate the poison. They may disappear for a time to reappear in some other form. The poison may lie dormant for years, and in healthy subjects show no signs of its presence till some weakening influence has depressed the powers of its victim, and given rise to a local affection in which the practised eye will read with more or less certainty the modifying influence of an antecedent syphilitic affection. The poison has been scotched for a time only, but not killed, and in the weakness of its possessor has reasserted its power.

No other animal poison appears to have such tenacity of existence. All others produce their specific effects in a definite way and in a regular series of symptoms, and are either eliminated or destroy life; having made their mark and run their course, they cease to act and are innocuous; their power for harm being exhausted. The poison of syphilis, however, is so subtle that it is tolerably certain most of the secretions of a syphilitic subject are capable of producing the same disease in another; clinical experience having disproved Hunter's opinion that syphilis could only be propagated by the secretion of a primary sore, and Ricord's proposition, that "a chancre at the period of progress is the *only* source of the syphilitic virus." Indeed, it may fairly be asserted that a healthy woman, marrying a man who has had syphilis but in whom all symptoms have long disappeared, may give birth prematurely to a dead fœtus, to a stillborn child, or to an infant that will, either at its birth or within a few weeks subsequently, show symptoms of syphilis, all these results being the effects of syphilis transferred from the father. When both parents are similarly diseased the evidence is still stronger. "The semen of a diseased man deposited in the vagina of a healthy woman will, by being absorbed, and without the intervention of pregnancy, contaminate that woman with the secondary form of the disease, and that without the presence of a chancre or any open sore either on the man or the woman." (Dr. Porter, 'Dublin Journal of Med. Science,' 1857.)

A healthy woman, marrying a man who has had syphilis, but who has lost all symptoms of it, may acquire syphilis through a blighted ovum, or a series more or less prolonged of stillborn children, the placental circulation between the fœtal and maternal blood being the infecting medium.

A healthy woman, giving suck to a child the subject of hereditary syphilis, may acquire the disease through some fissure of the nipple, the disease locally and constitutionally manifesting its presence with all the intensity of a primary inoculation.

Again, the secretion of any true syphilitic sore, chancre, or mucous tubercle, whether of the mouth, nose, anus, vulva, or penis, is capable of transferring the disease; and the syphilitic poison may probably be simply absorbed by the vessels of a part—*physiological absorption*—without giving rise to any local affection. Hunter believed this, and Lane, Marston, and Lee have published observations that tend to support the theory.

"It should never be forgotten that it is the virus which infects the system, and that the sore is the mere local lesion, and not a necessary antecedent to infection." (Committee on Syphilis, p. 8.) "It is impossible to predicate with absolute certainty of any given sore that it will or will not be followed by constitutional infection."—J. Lane.

It should never be forgotten that the poison of syphilis, introduced into the system, in whatever way, whether inherited or acquired from primary sores or from the secretions of a syphilitic subject, is the same and manifests its presence in much the same way.

It may be difficult in individual cases to make out the direct source of the contagion;

but if we recognize the fact that the virus, however diluted in one subject, may, when introduced into another, behave as if it had been taken from a spreading primary sore, the explanation of most clinical facts becomes easy.

Syphilis is an animal and a human poison; it is capable of propagation from the secretion of any syphilitic to a virgin subject in all its intensity, by any form of inoculation; it may likewise be inherited. Nothing is known of its nature, although its effects are sufficiently familiar. The syphilitic virus, writes Bumstead ('Venereal Dis.,' 1870), "is alone capable of infecting the system at large and of affording protection by its presence against subsequent attacks. Unlike the poison of gonorrhœa and of chancre, it is not limited to purulent matter, but exists in the blood, in the fluids of secondary lesions, in the semen, and probably in other secretions."

How, then, it may be asked, is syphilis to be recognized? Is it to be recognized in its primary inoculation, or is it only to be known by its constitutional symptoms?

It has been already stated that most authorities are agreed upon the fact that there is no form of local sore or chancre that can be said with certainty to be the result of the local inoculation of syphilis. In the cartilaginous indurated sore, with enlarged indurated glands, there is every probability of syphilis manifesting its presence; and in the multiple, suppurating, non-indurated chancre there is every probability of no such symptoms appearing. But in the first form such symptoms may not, and in the second they may appear. Consequently, as a law, this distinction becomes of little value. Indeed, syphilis as a constitutional disease can only be known by the manifestations of its symptoms, and not by the inoculation; in the same way as smallpox, when propagated by inoculation, is only to be recognized by the eruption, and not by the local appearances resulting from its inoculation.

Acquired syphilis.—Acquired syphilis is always contracted through inoculation from a chancre, or from a syphilitic mucous tubercle, condyloma, or other sore, or from the secretions of a syphilitic subject; the secretion of one form of syphilitic sore from one subject being capable of producing a chancre of another form in another subject.

Mr. John Morgan, of Dublin, by experiments, has been led to believe that "the discharge of a syphilitic female produces on *syphilitics* the sore identical with that produced from the soft sore or chancre."

After inoculation a certain time usually elapses before the poison manifests its presence, which varies from six to twelve weeks. In exceptional cases, the symptoms of syphilis may appear within the month, or fail to appear for four or more months, but every week that passes after the third month without their manifestation lessens the likelihood of their appearance, and when six months have elapsed without syphilitic symptoms showing themselves the probabilities of their doing so are very slight.

The different forms of syphilitic inoculation will be considered under the head of chancre, &c.

Dismissing, therefore, the consideration of the character of the sore to which the poison of syphilis usually gives rise, with the simple reminder that there is positively no specific sore, the constitutional symptoms of syphilis now claim attention; and the variety of forms they assume is very striking. They usually show themselves primarily upon the skin in the form of an eruption, or upon the mucous membrane of the alimentary canal, as indicated by sore tongue and throat, while some amount of fever and constitutional disturbance usually precedes their appearance, this "syphilitic fever" varying according to the nervous susceptibilities of the patient.

The skin eruption may be only a rose rash, *roseola*, giving rise to a mottling of the skin, or to a more lasting staining. It may assume the papular form, *lichen;* the pustular, *ecthyma;* the vesicular, *rupia;* the tubercular, ulcerating or non-ulcerating, or the scaly, *lepra*, or *psoriasis*. Bullæ are rare, except in hereditary disease; when present they indicate a cachectic condition.

The mildest form of roseola may last but a few days and disappear, or leave a dusky coppery stain behind of some durability.

The *lichen* will soon show the copper tint, and, as it flattens, may become a tubercle, and this a scale, the skin after the desquamation of the scale showing much the same as the macula of the rose eruption.

When the eruption is tubercular at the first, the same series of changes will be seen; the raised, indurated, or spongy tubercle, as it withers, usually showing a scale upon its surface, and then flattening down to a macula.

The *lepra* and *psoriasis* appear as inflamed patches more or less extensive, as in the non-specific forms, the epithelial scales varying in thickness and the fissures in depth. The psoriasis commonly appears on the palms of the hands and the soles of the feet.

All these eruptions have a copper-colored tint, more particularly after their first appearances have faded. But what is still more characteristic is the fact that upon the same subject several forms of eruption are often found together—the macula, papule, pustule, tubercle, and scale, passing one into another.

What determines the form of the eruption at its first appearance is not known. Why syphilis in one man should manifest its presence by an eruption of mere maculæ, in another by a papular or scaly eruption, and in a third by a pustular, tubercular, or ulcerative form is not known. The theory propounded by Carmichael, that each sort of eruption has its own form of local sore or inoculation, was ingenious, but not supported by facts, and the generally received opinion is that the peculiarity or power of the infected patient has more to do with these phenomena than the nature of the poison itself. The pustular and vesicular eruptions are more prone to appear in cachectic subjects than in the robust, and an ulcerative action to accompany, or rather to follow their appearance; the base of the pustule or of the vesicle, and at times the substance of the tubercle, breaking down, and giving rise to a troublesome and spreading ulcer.

As the *outside* skin in syphilitic subjects is attacked by eruptions, simple and ulcerative, so the *inside skin or mucous membranes* are equally involved. "Every form of syphilitic affection of the skin," writes Lee, "has its counterpart in the mucous membrane; but the appearances will be modified by the comparative thinness of the structure, by the absence of cuticle, and by the little disposition these parts have to take on the adhesive inflammation." The mucous tubercle is the more common form, and is found in organs of generation, tongue, mouth, lips, nose, palate, throat, rectum, and anus, and occasionally in other parts of the alimentary canal. It is known also in the larynx. At times these tubercles break down and ulcerate, giving rise to irregular excavated sores.

Moist tubercles may appear in syphilitic subjects at any part of the body where two skin surfaces are in contact, associated with moisture. When they are found between the toes they are known as *rhagades*, and when about the orifice of a mucous passage as a condyloma.

Syphilitic sore throat may appear as a mere mucous patch upon the surface of the mucous membrane, or at times as an ulceration of this patch, while at others it shows itself as a distinct affection, the throat becoming swollen and of a livid color, and rapidly passing into ulceration. These ulcers may attack the soft palate, pillars of the fauces, tonsils, or pharynx, and present every kind of appearance, shape, and character. They may be serpiginous like the trail of a snake, horse-shoe shaped or circular, superficial or excavated with sharp edges, inflamed, sloughing, or indolent. By themselves they are not typical of syphilis, however suspicious, and other concomitant symptoms are required to determine the diagnosis.

The mucous patch is the most characteristic. No ulceration is typical, although the sharply cut excavated ulcer is the most unmistakable.

In hereditary syphilis this form of excavated ulcer is rare, though I have seen the perforating ulcer of the soft palate in an infected infant a month old.

Syphilitic disease of the tongue is a very troublesome affection, and manifests itself in a variety of ways; it appears more commonly in the form of aphthous and mucous patches, ulcerating or otherwise, and not unfrequently the whole thickness of the organ is infiltrated with the gummatous syphilitic material, either as an isolated nodule or as a general infiltration. When this nodule has softened down and suppurated, a deep excavated sore or fissure may be left, not unlike that of cancer, and when this sloughs or is of a chronic nature, the diagnosis becomes still more obscure. In cancer, however, there is probably a more marked local induration than in syphilis, and rarely a sharp well-defined edge. The history of the case is, too, very different.

The mucous lining of the mouth, lips, nose, &c., is also equally liable to syphilitic disease, either in the shape of aphthous and mucous patches or of ulceration, not unlike that found on the throat or tongue; indeed the disease of one part of the mucous membrane is the same as that of all others, the local appearances and symptoms being modified only by the peculiarities of the part.

In ulceration of the rectum syphilis bears an important part, and as a cause of stricture is not rare. When present, the disease usually spreads upwards from the anus, the bowel being in some cases superficially, in others deeply infiltrated and ulcerated. This form of disease is more common in women than in men (*vide* Chapter XVI).

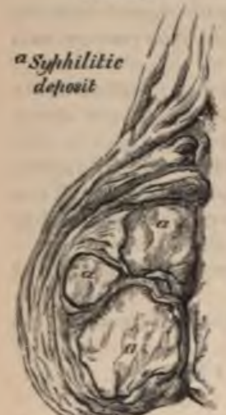
Syphilitic disease of the periosteum shows itself in the form of nodes, and rarely as a single node. If the tibia be involved, several swellings exist, and the same occurs in other bones, particularly the cranium. The swelling is merely an effusion of the gummy material beneath the periosteum. When the bones are attacked the disease is mostly chronic, and too often ends in death of the part, *i. e.*, in necrosis.

In disease of the periosteum, extreme tenderness and pain with local swelling are the chief symptoms. When the bones are implicated the pain is of a constant aching character, and this is always aggravated towards night, but there is neither such swelling, nor so much tenderness, as in the periosteal affection. In disease of the bones of the skull, the dura mater and brain may become secondarily affected.

It must not be thought, however, that syphilis and its effects are confined to those parts of the body that come under the immediate notice of the surgeon. It it hardly probable that both ends of the alimentary canal should show evidence of the affection without some part of its intermediate twenty-five feet being implicated, or without some of the compound glands that are associated with it being involved. The pathologist knows this to be the case, and recent research has confirmed Wilks's observation ('Guy's Reports,' 1863), that "the extent of the influence of syphilis is only commensurate with the tissues of the body," and that "there appears to be scarcely a tissue which may not be affected, and always in one particular and characteristic manner." The internal organs may be affected equally with the external; not only the cranium, but the brain within it, or the nerves; not only the muscles of the limbs and tongue, but the heart; not only the pharynx, but the œsophagus; not only the larynx, but the trachea, bronchi, and lungs, also the liver, spleen, and other viscera."

"The peculiar effect of syphilis on the system," says the same writer, "shows itself in a disposition to the effusion of a low form of lymph, or fibro-plastic material, in nearly every tissue of the body, occasionally modified in character to a slight extent by the organ in which it occurs. In solid organs or in the interior of the tissues there is found a more or less circumscribed deposition of an albumino-fibrous material, whilst on the surface of the body a similar material may constitute merely the base and border of an ulcer." In the testicle this is well seen (Fig. 12).

Fig. 12.



Half a testicle affected with syphilis.
2351^{48}. Prep. Guy's Hosp. Museum.

In these observations the whole pathology of syphilis is included, for whether syphilis involve skin, mucous membrane, connective tissue, muscle, bone, periosteum, or a viscus, the same exudation exists, either as an exudation and induration, or as an exudation breaking up with ulceration.

This exudation is the same in all stages of syphilis, in all tissues, in hereditary as well as in acquired syphilis. When the exudation is reabsorbed, a recovery is said to have taken place; when it breaks down, suppuration ensues. When it attacks the external tissues, secondary symptoms are said to exist; when the internal viscera or the bones are affected, the symptoms are called tertiary.

In cachectic and feeble subjects, where visceral mischief has a tendency to appear, syphilitic disease of the organs may occur. The bones, if affected, are liable to become necrosed; the larynx, to ulcerate; and the skin, when affected, to suppurate as well as ulcerate. In fact, syphilitic disease in the feeble and cachectic is as liable to be associated with disorganizing changes as any inflammatory or other affection. The longer the disease has existed, the greater also is the probability that the viscera and the tissues of the body generally will be involved. But in all other respects the effects of syphilis, are the same. The virus, as it affects the body in all its different ways, is the same; at all times it is the same; the so-called *secondary* and *tertiary* syphilis are the same, for these terms have no definite signification. They have, I believe, tended to confuse the subject rather than clear it, and were framed when the pathology of the disease was but little known. Syphilis is clinically known by certain constitutional symptoms, and pathologically by certain morbid conditions. It may manifest its presence in different subjects in different ways, involving now one tissue, then another, with no apparent law regulating its action. In one patient a tissue may be involved early, in another late; but the node on a bone, the nodule of lymph on the iris, the indurated gummy tumor in the connective tissue or in a muscle, the puckered nodule of fibrous tissue beneath the peritoneal covering of the liver, the mass of fibre tissue poured out in a syphilitic testicle, are all alike. These differ only in their symptoms and effects according to their position, yet whether they occur soon or late after the primary inoculation, is a matter of no clinical importance.

"While syphilis is thus unsparingly general in its attacks upon organs, yet it plays over much the same series of organs as other diseases; vulnerable or much-abused organs, which suffer disproportionately from common causes of disease, suffer also in much the same proportion from syphilis, while the thyroid, spleen, capsules, deep-seated bones, and, indeed, generally those parts which are not obnoxious to other 'common' diseases, escape also in syphilis" (Moxon, 'Med. Times,' June 24, 1871). In fact, beyond the local inoculation, syphilis fixes upon or rather attacks an organ much as any other disease, possessing no special predilection for one organ or tissue in preference to another; the so-called secondary and tertiary affections having no real difference, save only in the surgeon's mind.

TREATMENT.—There is no remedy in the pharmacopœia that can be relied upon as a specific for syphilis, although there are many that have a very beneficial influence in aiding the disappearance of the symptoms; they can, however, do no more. It is, indeed, a question whether the disease is really ever cured, whether a person once under the influence of syphilis is not really like one brought under the influence of vaccinia, which means, that his body has been so affected by the poison as to be influenced by it for life. After successful vaccination a second inoculation rarely takes as it does in a virgin subject, and after true syphilis a second attack rarely if ever ensues, Porter's law being tolerably proved, "that the influence of syphilis never returns upon itself, or re-contaminates the source from which it had been derived" ('Dublin Quart.,' 1857). Ricord, Lee, and others have proved that the soft or non-infecting chancre is the only one that can be inoculated with success on the same subject. It is true that in a large number of cases syphilis appears to be cured, that the symptoms disappear and the health of the patient is re-established; yet it is equally true that in such cases, after the lapse of years, even a quarter of a century, when, under some weakening influence by which the powers of the patient are reduced; by some local disease, such as an ulcer, the existence of former syphilis is again recognized. So long as the powers of the subject who had syphilis remained good, no evidence existed of its presence; but when these failed, the poison reasserted its claim to recognition. It must, however, be stated with considerable confidence that Nature, unassisted by art, seems incapable of eliminating the disease, or of arresting its progress.

In former times it was thought that in mercury the surgeon possessed a specific against the disease, and when all chancres were looked upon as syphilitic, and mercury was administered, a large proportion of supposed cures were recorded, no constitutional symptoms showing themselves.

In modern times, however, when it is known that at least three out of every four cases of chancres of the penis are local venereal affections and not syphilitic, the supposed success of the mercurial plan is not recognized; although in syphilis—that is, when the constitutional evidence of the disease is present—the power of mercury in getting rid of the symptoms is indisputable.

In strong and healthy subjects, therefore, when syphilis is present either in the form of skin eruption, sore throat, or other affection of the mucous membrane of the intestinal or respiratory tract, mercury is beneficial. The best mode of using it is generally supposed to be by inunction, the rubbing in of mercurial ointment, about the size of a nut, into the axilla twice a day, till the gums are touched, and after then only once a day. Dr. B. G. Babington recommended its being applied in adults to the soles of the feet, the rubbing in being performed by the action of walking. The internal administration in bark of the bichloride of mercury in doses of $\frac{1}{16}$th of a grain three times a day, is a good form of administration, as is also the green iodide of mercury in grain doses twice a day, with Dover's pill. Some surgeons still use the blue pill with opium. During the last five or six years I have been using the mercurial suppository twice a day, and have been greatly satisfied with its action; the drug acts as well this way as by the mouth, and in no way interferes with digestion or the functions of the abdominal viscera; indeed, I am disposed to think it by far the best mode of administering mercury. I know of no objection to its use. Next to this plan the calomel vapor bath is the best.

The most convenient calomel vapor bath, writes Lee ('Holmes's Surgery,' ed. 2d, vol. i), is one which was made at my request by Mr. Blaise. In this apparatus the lamp which sublimes the calomel boils the water at the same time. In the centre of the top, immediately over the wick of the lamp, is a small, separate, circular tin plate, on which the calomel is placed; around this is a circular depression, which may be filled one-third with boiling water; the apparatus being placed on the ground and the lamp lighted. The patient then sits over it, with an American cloth cloak or mackintosh fastened round his neck. He thus becomes surrounded with calomel vapor, which he is generally directed to inhale for two or three separate minutes during each bath. In doing this the patient should not put his head under the cloak, but simply allow some of the vapor to escape from the upper part, and breathe it mixed with a large proportion of common air. At the expiration of a quarter of an hour or twenty minutes the calomel is volatilized and the water will have boiled away—a portion of the calomel being deposited on the patient's body. The patient may then gradually unfasten his dress and put on his night dress, but must not wipe his skin. If he prefers it he may go to bed with the cloak and wear it. The bath ought to be used every night, and five or ten grains evaporated.

Bricheteau, Lewin, and Sigmond have employed the hypodermic injection of mercury with some success, throwing in 15 minims of a solution of corrosive sublimate, 4 grs. to the ounce of water. ('Brit. Med. Jour.,' 1869.)

For feeble cachectic subjects, however, mercury is ill adapted, and for such the iodide of potassium in five-grain doses, gradually raised to ten, or more, will do all that is needful. In London practice it is generally required to be combined with some tonic, such as bark, quinine, or iodide of iron. The combined use of mercury and iodide of potassium will occasionally be of great value.

When the mucous tracts are involved, the addition of some alkali such as the bicarbonate of potash, in ten-grain doses, to the iodide is advisable. The addition of the compound spirit of ammonia to the bark mixture is also useful.

When the symptoms begin to yield the treatment must be continued; indeed, the effects of the drugs, whatever they may be, should be kept up for at least six months after the disappearance of all symptoms, otherwise a relapse will ensue.

Comparing the effects of the two drugs together, it may be asserted that the mercurial plan of treatment is more applicable to the early than the late symptoms of syphilis; that in cases of relapses, or of a remote kind, the iodide of potassium is preferable, although under both circumstances in exceptional cases, one plan of treatment will succeed where another fails. When iodide of potassium cannot be tolerated, iodide of sodium may be substituted.

During the course of syphilis the patient should live well, on simple, nutritious, but non-stimulating diet. Wine and beer should be given in moderate proportions, spirits never allowed, and smoking, as a rule, should be interdicted.

When mercury is being employed the skin should be kept warm and the feet dry, all sudden chills being bad. When suppuration or ulceration exists in any form of syphilis, mercury is rarely applicable, iodide of potassium combined with tonics is then the best drug, with or without opium. Sarsaparilla has no specific influence in syphilis; it is a pleasant vehicle, but nothing more. Opium combined with other drugs is at times of great value; with mercury it is invaluable; it may be given in small doses whenever the nervous system has been overwrought and there is great irritability of pulse. "The soothing qualities of this admirable medicine," writes Pearson, "can scarcely be estimated too highly." In spreading ulcerations, whether due to local or to constitutional causes, opium is invaluable, either given alone or combined with iodide of potassium. In such cases mercury is rarely beneficial.

The syphilitic affections of the mouth, tonsils, throat, tongue, &c., are expedited in their disappearance by the local application of nitrate of silver, chlorate of potash, or borax lotion, constitutional treatment being simultaneously employed.

The **mucous tubercles** of the genitals and other parts are most successfully treated by the local application of calomel, which should be dusted over the diseased surfaces through a muslin bag. A good rub with nitrate of silver at times expedites the cure. The parts should be kept well dry.

Condylomata are not so amenable to the calomel treatment as the moist tubercles; they may, however, be successfully treated by the local application of nitrate of silver or sulphate of copper, by a lotion of bichloride of mercury gr. ij to the ounce of water, or of black wash. When the growths are very fleshy, excision is the best practice.

In ulceration of the throat iodide of potassium, in doses varying from six to fifteen grains three times a day, is of great value, with the local application of the nitrate of silver in stick or strong solution; a gargle of alum, chlorate of potash, or borax, a drachm to a pint of water, is also good.

In laryngeal disease the iodide must also be given quite as freely; and when ulceration has commenced, and seems to be unaffected by general treatment, tracheotomy claims serious consideration, because unless the larynx can be kept quiet, repair will not go on, and, so long as ulcerative disease is present, a sudden spasm of the glottis may occur and render imminent the death of the patient. The operation should, however, only be undertaken when the disease is steadily progressing in spite of treatment, and it is clear that the larynx will be destroyed as a vocal as well as a respiratory organ unless some steps be taken to stop its progress. Of these steps there are none equal to tracheotomy, for all surgeons are familiar with the fact that even under the most extreme conditions of disease repair goes on in the larynx directly the tracheal tube has been introduced, and physiological rest is given to the organ (*vide* paper by author, 'Clin. Soc. Trans.,' 1868).

In the *gummy tumors* of the tongue, muscles, and cellular tissue, large doses of the iodide with tonics are as beneficial as they are in the *periosteal* affections of syphilis.

There is reason, however, to believe that in the visceral as well as in other diseases which may be looked upon as the sequelæ of syphilis, or as the result of the cachexia caused by the disease and the remedies employed for its removal, iodide of potassium alone has little influence. Dr. Wilks has shown how the lardaceous and waxy diseases of organs are found after syphilis, and every one knows how little amenable to treatment these affections are; Dr. Dickinson has, however, done something to prove that they are due to a want of alkalinity in the blood, and are to be prevented and, in a manner, cured by the medical use of alkalies. With the same view a non-nitrogenous diet should be allowed.

During the later period of the disease, when the gummous depositions take place, whether it be visceral, osseous, glandular, or otherwise, iodide of potassium in full doses is of great value. In the sequelæ, in waxy or lardaceous disease, it is of little use, alkalies with tonics being then apparently the best. Upon this knowledge it is probable that the late Mr. Aston Key based his advocacy of lime water and the infusion of sarsaparilla in the syphilitic cachexia.

Hereditary Syphilis.

That syphilis is capable of being propagated by hereditary transmission is a clinical fact generally recognized, constituting the main distinction between syphilis and all other animal poisons. To what an extent this influence spreads is still a debatable question. According to some observers, instead of diminishing, the radius of its action appears to be yearly increasing.

That the child of a parent who has had syphilis *may*, *not must*, inherit the disease is generally acknowledged, and, when both parents have been affected, the probabilities of its transmission are, doubtless, increased; but data are still wanting to determine under what circumstances the offspring of such parent or parents is likely to be thus affected, or to be born healthy, and whether maternal or paternal influence is the greater.

There is, however, some reason to believe that when the mother is at fault the early conceptions are more likely to be blighted, and the later come to maturity; whilst when the father is at fault the first conceptions show few, if any, signs of the affection, the symptoms becoming more marked at each succeeding one, till at last the ovum becomes blighted and the wife constitutionally affected.

Daily experience proves, however, that a man who has had syphilis and lost all traces of it under treatment, who enjoys good health, and marries a healthy wife, may be blessed with healthy children, in whom no traces of syphilis can be found; and the same experience also indicates that like subjects, marrying in a less vigorous condition of health, or lapsing into it, may give rise to diseased offspring. The probabilities of the child being affected, as well as the degree of the affection, turn much upon the period of time which has elapsed between the disappearance of the constitutional symptoms in the parent and the date of marriage.

A certain number of children, writes Lancereaux, succumb in their mother's womb to syphilis, solely because they are already affected with the disease. At other times the children come into the world with lesions unmistakably syphilitic; while in the great majority of cases the child who inherits syphilis has at first the appearance of health, and, some weeks after birth, presents signs which betray the evil transmitted to it from its parents, it being usually from the first to the third months of extra-uterine life that syphilis manifests itself in the new-born child. Cullerier, however, gives a year as the latest time for the disease to show itself.

With respect to the symptoms of hereditary syphilis, it may be well to assert at the beginning, that, with the exception of the primary inoculation, they are much the same as those of the acquired disease. Affections of the skin are found associated with those of the mucous membranes, bones, or viscera; and these manifest themselves in no definite order.

At birth the child may be plump and fat, and for some days appear healthy in every respect. After the lapse of a few days some difficulty in breathing will probably appear, with symptoms of cold in the head, these so-called "*snuffles*" being always suspicious. At this time, if the skin be carefully examined, more particularly about the buttocks and feet, some eruption will be seen. This may be simply a staining of the skin, or a more definite papular, vesicular, or pustular rash; it may be associated with some affection of the internal skin or mucous membrane, mucous patches, or condylomata showing themselves at the anus, about the mouth or within it, around the nose, or other parts. The seat of the eruption is greatly determined by the degree of cleanliness observed, the irritation of dirt and moisture in any locality in syphilitic children being followed by condylomata or mucous patches.

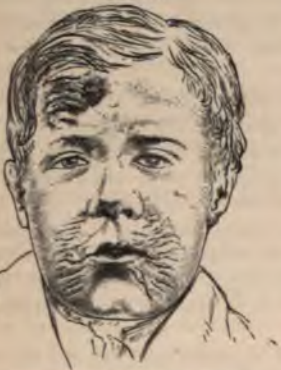
The orifices of the nose, mouth, and anus are at times fissured in a very marked manner, and occasionally exhibit manifestations of the disease which can never be mistaken, even years afterwards. In the annexed drawing these alterations about the face are most typical (Fig. 13).

When the disease is allowed to run its course the child's general condition suffers, it becomes emaciated and puny, the digestive organs become deranged and refuse to assimilate food, however good; while vomiting and diarrhœa are common consequences. Evidence of starvation soon appears, the skin becomes baggy, and of a peculiar dusky hue; when not covered or scarred with eruptions it may have a jaundiced appearance, and the child will probably die from what is called marasmus, which means wasting from starvation.

When the disease does not run so rapid a course, other symptoms show themselves. It may be in the skin, bones, eye, ear, or viscera.

In the *skin*, subcutaneous, or submucous tissues, the disease may appear in the form of *gummy swellings* or *tumors*, which may break up and give rise to irregular excavated cellulo-membranous abscesses. In the *bones* the disease may show itself as nodes, the humerus appearing to be the bone most commonly affected, though I have seen several instances in which the bones of the skull were frightfully involved.

Fig. 13.



Hereditary syphilis, from life.

In the eye the symptoms are well known; the *interstitial keratitis*, a form of disease, according to Hutchinson, which is peculiar to hereditary syphilis, generally shows itself between the ages of eight and fifteen years. It appears as a diffused haziness of the centre of the cornea, unattended with ulceration; this haziness begins in independent patches, which subsequently coalesce, the cornea, at a later date, appearing like ground glass. The affection is attended with photophobic pain about the orbit and sclerotic injection. It generally involves both eyes seriatim. Under treatment the disease may be arrested, but when it is severe, patches of haziness remain which interfere with vision, and at times cause complete blindness (Fig. 13).

Iritis is also another complication, though a rare one, as is *choroiditis* and also *amaurosis*.

Deafness is not unfrequent, the hearing failing without any external disease, such as otorrhœa. In most cases both ears are affected.

Hydrocephalus and syphilis are also allied. *Syphilitic* disease of the testicles is also to be met with. I have seen several cases of this nature, and the most marked was in a boy, the third child of syphilitic parents, four months old, who had snuffles and mucous patches on the lips. Each of the testicles was an inch and a half long and very hard. The disease was cured by mercurial treatment.

There is reason to believe, moreover, that in hereditary, as in acquired syphilis, every organ of the body, in different cases, may be found diseased, the viscera of the cranium, thorax, and abdomen, with the glands generally, as well as the skin, mucous membrane, muscles, nerves, and bones.

How far the syphilitic poison follows the subjects who inherit it is difficult to decide. It is no uncommon event to find a child, entirely free from all evidence of constitutional syphilis, born of parents who had previously given and may subsequently give birth to stillborn or diseased offspring. A healthy child may stand alone in a long series of conceptions as a living proof of the power of life even over such a poison as syphilis.

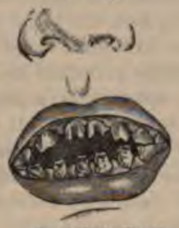
I have also before me the notes of an instance of twins born of syphilitic parents; one passed through all the series of complaints common to hereditary syphilis, while the other escaped altogether, that is, at the end of a year and a half no symptoms had appeared.

I have the notes of another case of twins, born under like circumstances, in which the symptoms appeared in one at the end of a month, and in the other in the fourth month.

Such cases as these would appear to show that the manifestation or non-manifestation of the symptoms of hereditary syphilis depends much upon the personal power of the child who inherits it, a strong child throwing off or eliminating the poison, while the weak falls under its influence; since in the case of the twins above mentioned there can be no question as to the similarity of the conditions under which they were placed. In hereditary syphilis this conclusion is founded upon strong evidence, and in the acquired it is at least probable.

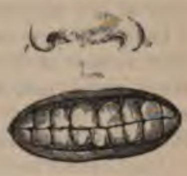
Amongst the evidences of hereditary syphilis established by Mr. Hutchinson there are often present in the permanent teeth important indications, so important, indeed, that, when present, the existence of hereditary syphilis may with some confidence be pronounced. They, however, exist only in exceptional instances of hereditary syphilis. "*The central upper incisors of the second set are the test teeth;*" these are usually short and narrow, with a broad vertical notch in the edges, and their corners rounded off (Fig. 14); horizontal notches having nothing to do with syphilis.

FIG. 14.



Syphilitic Teeth.

FIG. 15.



Healthy Teeth.

"Next in value to the malformation of the teeth," writes Hutchinson, "are the state of the patient's skin, the formation of his nose, and the contour of his forehead; the skin is almost always thick, pasty, and opaque. It also shows little pits and scars, the relics of a former eruption, and at the angles of the mouth are radiating linear scars, running out into the cheeks. The bridge of the nose is almost always broader than usual and low, often it is remarkably sunk and expanded. The forehead is usually large and protuberant in the regions of the frontal eminences; often there is a well-marked broad depression a little above the eyebrows. The hair is usually dry and thin, and now and then the nails are broken and splitting into layers. Interstitial keratitis is pathognomonic of inherited taint, and when coincident with the syphilitic type of the teeth, the diagnosis is beyond a doubt."

In Fig. 13, every point in this description is illustrated except with reference to the teeth, which were unusually good.

TREATMENT.—To help the disappearance of the symptoms of hereditary syphilis, remedies are of great value, and in an infant showing evidence of any constitutional power, the prospects of a recovery are very good. When the child is being suckled, whether the mother shows symptoms or not, I administer my remedies, and have done so for many years, through the mother, giving her from six to ten, or sixteen grains of iodide of potassium with quinine, or other tonic mixture, three times a day, half an hour before the child is put to the breast, and I have been much impressed with the excellent results of the practice.

When this process acts slowly I give the child in addition a grain of gray powder, with three or four grains of dried soda, every night. Before this I administered the gray powder and soda twice a day, or rubbed in about ten grains of blue ointment every night on the soles of the child's feet, the abdomen, or the axilla, but I much prefer the practice previously laid down. In young infants the mercurial ointment may be put on the belly-band, and thus rubbed in. As the snuffles disappear, the eruption and mucous tubercles fade, and the child begins to fatten and show signs of progress. The treatment should be kept up for at least a month after the disappearance of all symptoms.

The chlorate of potash treatment in some instances is doubtless attended with no unfavorable result, strong infants with care and nursing battling through the disease and possibly eliminating it. But the weaker die, when through more active measures they might probably have been saved; for many apparently hopeless victims of hereditary syphilis become under treatment strong and healthy infants.

A child with hereditary syphilis should under no circumstances be suckled by any other than the mother, for many a healthy wet nurse has been inoculated by such a criminal practice. When the mother cannot attend to the child it should be brought up by hand.

SERPIGINOUS ULCERATION.

This is a rare and somewhat singular form of venereal disease. It would seem to be more closely connected with the local suppurating non-syphilitic sore than the syphilitic, for it is rarely if ever associated with constitutional syphilis. It usually appears in the groin or thigh after a suppurating bubo, the result of a suppurating, non-syphilitic chancre; the opening in the groin spreading in crescentic patches of ulceration, one part of the sore increasing while a second is healing; when the cicatrix forms it presents a smooth glazed appearance. This ulceration is most obstinate, indeed, medicine appears to have little or no influence on its progress, and it may so spread as to extend over the thighs and lower part of the abdomen, and continue at intervals for years, but wearing itself out at last. I have seen one case in which it spread as high as the umbilicus and as low as the knee. The disease at one time promises to heal and then spreads without any clear cause. It is often found, too, in apparently healthy subjects, and appears to follow some course of its own that is not yet understood. It should be added that this sore is capable of being inoculated upon the same subject, the point of inoculation taking on the same action.

TREATMENT.—Mercury and iodide of potassium appear to have little or no influence on this malady; and if the view indicated by its course be correct, that the disease is not syphilitic, such a result is only what should be expected. The local treatment of the sore seems to be the most important, and the best practice consists in the local application of some strong caustic, such as nitric acid, carbolic acid, or the cautery, either galvanic or actual, the patient being under the influence of some anæsthetic. Opium in moderate doses is of use, and so also are tonics, but in a general way the subjects of this affection are in good health. In several instances I have found a sea voyage of more value than any other treatment. In three cases the sore rapidly healed after the operation of skin grafting had been performed.

When may a man who has had syphilis marry? is a question which is often asked, and, to answer it with any degree of confidence is no easy task, assuming, as I do, that the opinions laid down in these pages are correct, that a man who has once had syphilis is never free from its influence, and that the poison once in the body may reveal its presence a quarter of a century after all external evidence of its existence in the form of local disease has disappeared.

A man who has had syphilis may, therefore, when he marries, so affect the ovum of his wife as to cause its death, or produce some evidence of disease, or feebleness; or if the wife be healthy and he himself in good condition and free from evidence of the disease, the offspring may escape altogether and appear as healthy as that of other uninfected parents. Indeed, it would appear that if a man marries when in robust or good health a year after all evidence of the disease has vanished, he may be the father of a healthy child; but if his general condition fails and he becomes cachectic, the poison seems to have the power of reasserting its influence and manifesting its presence by some feeble or even diseased condition of the subsequent offspring.

When the mother is affected with the disease the same risks are run.

Every parent who has had syphilis runs the risk of giving birth to feeble or diseased offspring; these risks are diminished by the general vigor of the parents, and increased by diminished power. No man should marry so long as the slightest taint of the disease manifests its presence, but if in good health, and free from all evidence of its presence for a year, marriage may be contracted. To ask for a longer delay when such a step is contemplated is unfair and unnecessary; a risk must be run, and the lapse of a longer period will not lessen it.

Inoculation and Syphilization.—Ricord was the first surgeon who employed inoculation for diagnostic purposes in venereal affections; and through his experiments he was led to the conclusion, that "a chancre at the period of progress is the only source of the syphilitic virus." As a test of the simple suppurating sore it may now be employed, for a second sore can readily be obtained by inoculating a patient from the pus of his own primary one. Indeed, this process of auto inoculation may be continued for a long series, but only with any effect from the suppurating sore. In the syphilitic sore no inoculation will take, and in the inoculation of common pus no reaction occurs, or next to none, a simple pustule probably alone appearing.

From these clinical facts it would appear that common pus, the pus from a suppurating non-syphilitic sore, and that from a syphilitic one, are very distinct, including under the term syphilitic any sore that is followed by syphilis.

By inoculation, therefore, a surgeon may fairly determine the fact as to the nature of a chancre, and, under some circumstances, the evidence obtained by the practice may be valuable.

Syphilization originated in 1844 through some experiments of M. Auzias Turenne upon animals to inoculate them with syphilis; and in these he found, that, after a number of inoculations, they became proof against the syphilitic virus. It was followed up by M. Sperino, of Turin, and extensively employed by Professors Boeck, Faye, and Bidenkap, at Christiania, several hundred cases having been treated upon the principle, the object being "to cure syphilis."

The theory as expressed by Boeck, "that the syphilitic virus, by continued inoculation, annihilates itself," was practically carried out by inoculating a patient the subject of syphilis with fresh matter from any active venereal sore of any kind till the inoculations failed to take. The inoculations were repeated every three or four days, first on the body, then on the extremities. When inoculation is no longer possible, "the treatment is finished, and the patient has recovered his health."

Boeck never practised syphilization until the constitutional symptoms appeared, for, says he, "I cannot double a malady already present, so I am quite certain not to do harm to the patient." Syphilization is not used with equal success against all cases of syphilis. "In those that have not been treated with mercury, the progress of syphilization will be regular; the syphilitic phenomena will vanish away, immunity will take place eventually, and recovery be attained with certainty. In those who have taken mercury, syphilization is not so certainly useful; it ought to be tried; it does often cure syphilis entirely, and at least does good."

These are Boeck's conclusions; but I need hardly add, they are not those of British surgeons. The practice has been mentioned and briefly described, but not to be recommended. It has no single advantage, and is certainly loathsome. We are decidedly of opinion, write Lane and Gascoyen, in an able article on the subject, "that syphilization is not a treatment which can be recommended for adoption. We consider that, even if it could be admitted to possess all the advantages claimed for it by its advocates, its superiority over other modes of treatment, or in many instances over no treatment at all, would not sufficiently compensate for its tediousness, its painfulness, and the life-long marking which it entails upon the patient." ('Med. Chir. Trans.,' vol. l.)

VACCINO-SYPHILIS.

That syphilis may be transferred by means of vaccination is a fact which must be honestly recognized, although where it has occurred it seems more than probable that something more than the unmixed lymph of the genuine vaccine vesicle had been employed, such as the blood of the vaccinifer; for no one can now well dispute the possibility of inoculating syphilis when the blood of a syphilitic vaccinifer is transferred with the vaccine matter to a non-syphilitic subject. Whether it be possible to transfer syphilis through unmixed vaccine lymph is still an open question. In this country, such a misfortune as a syphilitic inoculation through vaccination has been happily rare, and only in recent days has the attention of the great body of the profession been directed to the subject. In Mr. Hutchinson's paper, and in the report of the Med.-Chir. Society for 1871, there will be found sufficient material to prove the truth of what has been written; and in Dr. Seaton's 'Handbook on Vaccination,' and in Dr. Ballard's work, all that is known on the subject may be ascertained.

To guard against the possibility of repeating these errors, the vaccinator should be careful to transfer only the unmixed vaccine matter; he should select also, when possible, a healthy vaccinifer, who is the second child of a woman whose first-born is healthy, and in whom there is no history of miscarriages. When any suspicion of syphilis exists in either parent, the child of such parents should be set aside and not used as a vaccinifer, however healthy and perfect the vaccine vesicle may be. The cleanest instrument should be used, and the same should never be employed for a second operation until washed. It would be also well, for the purpose of keeping up a good supply of vaccine, occasionally to vaccinate direct from the heifer.

With these precautions vaccination may be regarded as a perfectly safe operation.

Without them the risks of syphilitic inoculation, although slight, exist. They tell, however, but little against the enormous advantages of vaccination.

Lee, 'Holmes's System,' ed. 2, vol. ii.—*Marston*, 'Med.-Chir. Trans.,' vol. xlv–vi.—*Lane and Gascoyen*, 'Med.-Chir. Trans.,' vol. 1.—*Bumstead*, 'Edit. of Cullerier,' Philadelphia, 1868.—*Porter*, 'Dublin Quart.,' 1857.—*Lancereaux*, 'On Syphilis,' New Syd. Soc.—*Wallace*, 'On Venereal.'—*Carmichael*, 'On Venereal.'—*Hutchinson*, 'Syphilitic Diseases of Eye and Teeth.'—'Report of Committee on Venereal Diseases,' 1868.—*Turenne*, Académie des Sciences, 1850.—*Boeck*, 'Edin. Med. Journ.,' 1858.—'Dublin Journal,' 1857.

CHAPTER III.

TUMORS.

In the pre-pathological period, before the minute anatomy of healthy and diseased tissues was understood, and the microscope had rendered intelligible subjects that still rested in darkness, *tumors* had, from necessity, been studied simply in their clinical aspects, and surgeons, in their attempts to classify them, were guided solely by the most obvious characteristics of the growths, and by their real or fancied resemblance to the natural tissues of the body. As time advanced, more ambitious attempts at classification were made, and the most important work was that of *Abernethy*, who at the beginning of this century published his 'Attempt to form a Classification of Tumors according to their *Anatomical Structures*.' In that able production he asserted "that the structure of a tumor is sometimes like that of the part near which it grows; and sometimes unlike; that in many cases the nature of the tumor depends on its own action and organization, and merely receives nourishment from the surrounding parts." He thus gave expression to pathological truths of the greatest importance, and that still remain incontrovertible. The next real advance was due to Bichat, who recognized the essential difference between tumors and the parasitic nature of the cysticercus and echinococcus, although by his followers this parasitic notion was carried out far too fully, for they looked upon cancer as the product of a parasitic growth of entozoa. It was left, however, to Lobstein of Strasbourg, to embody Bichat's idea, and to give it full expression, which he did by naming those tumors *homœoplastic* which were similar in structure to the natural constituents of the body; and those *heteroplastic* which were composed of products which differ from the normal tissues. Since that time countless workers have been examining tumors and attempting to classify them—one of the most prominent being Lebert, and to him must fairly be attributed the credit of assigning specific elements to specific tumors, each tumor having, in his opinion, a definite structure; cancer was to be known by the caudate fusiform cells that even now are looked upon by some as typical of the disease. This notion of specific elements was very feasible, for it simplified knowledge and induced men to think they had a ready means of deciding upon the nature of any new growth; and, had it not been for Virchow, it is probable the theory would have long held its ground. In this learned pathologist, however, it found an opponent of consummate power, and as his reasons for disbelieving it are the groundwork of his great book on 'Cellular Pathology and Tumors,' it is well to have them in his own words:—

"In Germany the doctrine of specific elements has from the first made few proselytes, and now it is entirely abandoned. From the commencement of my career I have been compelled to combat this error, and I believe that at the present moment we are in a position to demonstrate in every direction, that there do not exist in tumors true specific elements which have no analogy with the normal tissues. It is enough for that to remember that the tumor, however parasitic it may appear to be, *is always a part of the body from which it springs*, and that it is not developed in an isolated manner at the expense of some juice, at some one place in the body, by the inherent force of this productive juice. To admit such a mode of development, *de novo*, was possible at a time when it was also believed that entozoa were spontaneously developed in the body at the expense of a liquid or an excretion, by equivocal generation, when no idea had been as yet formed as to how a cysticercus arrived in the abdomen, and there was able to develop itself and grow. There was no other opinion which medical men could then form save that entozoa sprung from animal substances, either from the tissues themselves or from the intestinal mucus (*saburra*). In the present day, when it is known that entozoa always penetrate into the body from without, by a way, often it is true, extraordinary, yet always natural, the analogy can no longer be invoked. This is still more evident since we have come to know that in a free exudation there is no new element produced; that, furthermore, the elements of the body itself have a legitimate origin from father and mother (or, to speak more correctly, from father or from mother, for it is a case of parthenogenesis), so that we must completely abandon the idea that a tumor can develop itself in the body as an independent being. *It is a part of the body;* it is not merely contiguous to it, but proceeds from it and is subject to its laws. *The laws of the body govern also the tumor.* This is the reason why it is not an object of natural history that one can regard as foreign from the elements of the body; it is, on the contrary, to be looked upon as embraced within its limits. . . . Hair may make its appearance and grow at a place where we do not expect to meet with hair. But no one will fancy or believe that feathers will grow in the human body. As a matter of fact there are tumors in man which contain hair, and in cutting up geese, tumors are sometimes found containing feathers. But if ever a man engendered a tumor with feathers, or a goose, one with hair, this would be a production *sui generis*, because the thing produced would deviate from the type inherent to the individual.

"*The type which in general governs the development and formation of the organism, governs equally the development and formation of its tumors.*

"There does not exist a new, different, independent type.

"What is established by logic in this matter results also from the direct observation of tumors themselves. This is why I deny that there is any heterology in the sense in which it has been maintained since Bichat's time, or such as was supposed even before then, that is to say, that a tumor could develop itself and exist in the body in accordance with some quite new plan, some new law. I go further: each species of tumor, whatever it may be, answers in its important parts to the elements of the body, the type of which is known, and the capital difference amongst divers tumors resides in this, that tissues normal in themselves appear under the form of a tumor, sometimes in regions where this tissue normally exists, sometimes in places where it does not exist in the normal state of things. In the first case I speak of it as *homology*, in the second as *heterology*.

"Wherever a normal tissue appears at a point which already contains some similar tissue, then as a consequence the new tissue is identical with the old, so that the type of the new production answers to the type of the pre-existing tissue; in this case the new tissue, the tumor, is homologous; when, on the contrary, the new type does not correspond with the old one, when it deviates from the pre-existing type, or that which is the original and normal one of the region, then there is heterology. But this latter has likewise its analogue in the body, only in another part of the body from that in which the tumor is situated.

"We cannot, in my opinion, distinguish tumors according to the tissues, in such a fashion that tumors containing certain tissues are to be regarded as homœoplastic, whilst those containing certain others are to be set down as heteroplastic; quite the contrary, *the same kind of tumor may be, under certain circumstances, homologous, and under other circumstances heterologous.* The same sort of tumor may at one time appear at a point where it is merely the expression of an excessive development of the tissue normally existing at this point, at another time at a place where this tissue is not in existence, and where its development is abnormal and strictly pathological. Let us take an example: a tumor may be formed of cartilage. The cartilaginous tumor is homologous, not because it is formed of cartilage but only if it springs from cartilage, if in this place there is cartilage already. Thus, a costal cartilage may be the point of origin of an enormous cartilaginous tumor; this is homology. But it is also possible for a cartilaginous tumor to be developed in the testis, which contains no cartilage, where this tissue should not be met with; here the same product constitutes an heterology."

Homology and heterology have, therefore, very different meanings as used by Virchow and other writers. In Virchow's language a tumor is *homologous* when it corresponds in structure with the tissue *in which it grows;* and *heterologous* when it deviates from that structure. A tumor that is homologous in one position may be heterologous in another. On the other hand, in the French and other schools a tumor is *homologous* when built up of elements naturally existing in some tissues of the body; *heterologous* when composed of elements that deviate from the natural structures, these definitions having nothing whatever to do with the position of the tumor. In Virchow's language the terms are relative; in that of other pathologists they have a definite clinical meaning of no slight importance, for homology means innocence and heterology malignancy in a tumor. Virchow, however, admits that his heterologous tumors are suspicious, although *every heterologous tumor is not of a malignant nature.* "There are a great many such tumors borne without any ill consequences, and whose properties are quite similar to those of which the nature is benign. Malignancy follows a certain scale among heterologous tumors, from species to species; and we are able to show how it is manifested more and more strongly—for the most part following two directions. In the first place, heterology is distinguished according to the degree which it attains. The tissues of connective substance have a much nearer relationship existing among themselves than they have with epithelial tissues or with the specific animal tissues. When, therefore, a cartilaginous or bony tumor is developed in connective tissue, or even a mucous tumor in adipose tissue, that is not nearly so heterologous as when an epidermoid tumor is formed in connective tissue, or a tumor of cylindrical epithelium in a lymphatic gland. A cartilaginous tumor which is developed in connective tissue, or in the tissue of bone, is indeed heterologous, but it is not so to the same degree as an epithelial tumor or a muscular tumor would be in the same place. But a still more important circumstance is this, that tumors engender certain liquid substances which we speak of under the name of juice. This is the humor or juice of the tumor of which much has been said."

"This parenchymatous juice is sometimes related to the cells, sometimes to the intercellular substance; and accordingly it appears under the form of fluid either intracellular or intercellular, contained in the cells or interposed among them in a liquid state like serosity. Whenever a tumor contains much juice, it gives evidence of more troublesome properties, and it possesses to a high degree the property of infection. A dry tumor of the epidermoid kind is by far less dangerous than a moist one; a soft cancer is much more to be dreaded than a hard one.

"The more a tumor is poor in vessels the less it will extend its infecting action beyond the neighboring parts; but the more it is rich in bloodvessels and lymphatics, the more it is traversed by the blood and lymph; the more the parenchymatous juices are in contact with the blood so much the more is the infection likely to become general.

"I give thus an interpretation of facts, but it is in accord with observation. The degree of contagiousness of tumors increases in proportion as they become more rich in vessels, and that alongside the vessels they contain an abundance of liquid materials. Every soft succulent tumor is suspicious, and that just in proportion as it contains many vessels and cells. The more the juice is intercellular and in contact with the vascular stroma of connective tissue, the more the malignant properties which are manifested by an ever new excitation to the progressive production of the tumor.

"I ought, indeed, to speak more at length as to the nature of these juices, but in truth I do not know what to say upon the subject. The results which chemists have arrived at on this subject have no kind of value. Here the field is open to inquiring and progressive spirits; and I hope that hereafter researches will be undertaken in this direction, and that they may be crowned with success."

But as this is not a work on pathology, I cannot allow myself to enter further into these speculations, and must refer the reader to Virchow's masterly work on 'Cellular Pathology and on Tumors' for a fuller elucidation of the subject.

In the sequel I shall regard tumors in their clinical aspect alone, giving their anatomical characters only so far as they illustrate the practical aspects of the subject. All speculative pathological doctrines will be set aside, as tending to confuse rather than to elucidate clinical phenomena, until the day when pathological science shall have so far advanced as to allow of an anotomical classification of tumors being made that will fully dovetail in with that founded on clinical observation. The microscopical anatomy of tumors has been furnished by the pen of my friend and colleague Dr. Moxon.

I propose to lay down here some few pathological points which have an important clinical bearing, and which tend to illustrate the subject of the diagnosis of tumors.

A tumor may be defined to be a new growth, cystic or solid, infiltrating, separate from, or continuous with, normal tissues. It is an addition to, not an increase of, natural parts, for such is an hypertrophy; and it manifests its independent existence by its disposition to grow irrespective of the part in which it is placed. All tumors, with the exception of the hydatid, are made up of one or more of the natural elementary tissues of the body, in a rudimental or morbid state, and in no single example has any extraneous or new element ever been detected. For just as the natural body is built up of cells and fibres in one or other of their different forms, so tumors are made up of like elements, although it may be of unequal proportions. Tumors, like the natural tissues, differ therefore, anatomically, according to the nature of the elementary structure of which they are omposed; and this again appears to be materially determined by the part of the body in which they are developed.

From this, therefore, a second leading principle may be fairly deduced, viz., *that all umors partake of the nature of the part in which they are developed, and are more or less made up of the elements which naturally enter into its formation.*

Hence a tumor developed in the stroma of a fibrous structure will probably be fibrous; f connected with bone more or less osseous; and if situated in a gland, it will in all probability partake of the gland structure. But new growths never assume the complicated tructure of a fully developed gland, they only in a degree simulate it. Wilks well expresses it when he says that "the great difference between physiological and pathological formations appears to be that nearly all new growths are of the simplest composition, not putting on the form of the complex organs near which they may be placed, but consisting principally of cells and fibres." The cells and nuclei of a part, instead of developing into normal tissues, err in their course, multiplying and possibly growing, and "whilst conforming generally with the part in which they are placed in minute structure and composition, yet they more and more widely deviate from it in shape and size." (Paget.)

The practical bearing of these pathological principles is by no means unimportant; because to the surgeon who has once recognized the true position of a tumor, there is a certain amount of probability as to its nature, which will at once suggest itself to his mind. If the tumor is situated in the skin or subcutaneous tissue, a strong probability exists that it will be composed of some one or other of the structures of the tissue; thus it may be the sebaceous tumor, which is rarely found in any other position, or, the fatty, for these two materials enter largely into cutaneous structures; or, it may be one of the fibrous or fibro-cellular nature, fibre-tissue existing abundantly also in these parts. Should the tumor be located between the muscles of a part, the tumor will probably be composed of connective-tissue elements, in the form of a sarcoma; being either a myxomatous, fibro-nucleated, or fibro-plastic tumor. Should bone, again, be the seat of the disease, some one of the elements of bone will, to a certainty, enter into its formation; the probability of its being an enchondroma, an osseous or a myeloid tumor naturally presenting itself to the mind. And, lastly, should a tumor be present in a gland, such as the breast, uterus, or prostate, the probability of its being an adenoid or glandular tumor cannot be overlooked; for pathologists now all recognize the fact of the close resemblance of tumors so situated to the natural gland structure. Even in carcinomatous tumors, if modern recorders are to be relied upon, the same principle holds good, for according to Waldeyer ('Archives,' Band xli, 1868), "Carcinoma is essentially an epithelial growth, and only occurs primarily where true epithelium already exists. Secondary carcinomata can only be produced by the direct propagation of the epithelial cells, which may be transported from their primary seat either through the lymph vessels, or as embola are carried through the bloodvessels to a suitable place where they develop like the germs of entozoa."

Tumors are either simple or cancerous, innocent or malignant; the simple or innocent approaching, in their nature, to the more highly organized natural structures of the body, even to the perfect glandular; and the malignant or cancerous simulating the more elementary or embryonic. As the normal tissues were formed from a simple cell, and in their higher grades are but a development of that cell or those cells, so the cancerous element consists in a persistence of the simple cell type or that of the undeveloped embryonic nucleus. The group of cases called "recurrent" must be placed in an intermediate position, for while in their earlier stages they tend to build up embryonic tissue, this subsequently becomes lost in cell proliferation.

In proportion, therefore, to amount of the cell element in a tumor its cancerous tendency may be determined, and the greater the proportion of the fibrous or well-developed structure, the greater probability of its nature being innocent or simple. The more a tumor simulates the natural structure of a tissue or gland, the greater the probability ot its being innocent; the more a tumor simulates the undeveloped cell structure, the greater the certainty of its being cancerous; malignancy appearing to diminish in proportion as the cells become more fully developed. As moreover it is in the nucleus of a cell that the active principle of its growth is to be sought, so it is clear that the more the tumor is composed of nuclei the more malignant is its nature, and the better the formation of the cell-wall the less malignant is the growth.

The nearer a new growth approaches, both in its elements and in the arrangements of its elements or structure, to the complex organs of the body, the greater are the probabilities of its being innocent; new growths under no circumstances equalling the perfection of a true gland tissue. Cancer being a purely cell tumor, growing indefinitely where the least resistance is met with, and having no other than cell structure, is, according to Wilks, "an objectless cell growth."

Tumors never change their original nature, nor pass or degenerate into others of a different kind. A simple tumor remains so to the end, and a cancerous tumor is cancerous from the beginning. The above lines are not intended, however, to convey the impression that a patient, the subject of a simple tumor, may not become the subject of a malignant one, or *vice versâ*, because such may unquestionably ensue; and after the removal of a simple tumor a malignant one may secondarily make its appearance. But no simple tumor by growth or degeneration will become malignant, as no malignant tumor will become innocent. It would, however, appear that in recurring innocent tumors there exists an increasing tendency in such growths to present on each return the elementary character of malignant growth, and "that a tumor which, under ordinary circumstances, is loath to contaminate the system may do so under the favoring influence of a long period of time," either as a recurring tumor or as a more malignant one.

Simple tumors separate tissues in their growth, but never infiltrate; cancerous, as a rule, infiltrate, and rarely separate. No more important practical point than the above can be adduced to aid the surgeon in his diagnosis of a tumor. A simple or innocent tumor, however long it may be in growing, or large a size it may attain, will never do more than separate the parts between and beneath which it may be developed. The bones may be absorbed by its pressure, but they will never be infiltrated; and the skin may be so stretched and attenuated by its distension as to ulcerate or burst, but it can never be infiltrated with the elements of the tumor. This fact is well exemplified by a close examination of the margin of a cutaneous opening, the result of over-distension; for it will appear as if cleanly cut, or rather punched at its edges, and never thickened or diseased. An intra-cystic growth may project from it as a fungus, and put on many of the appearances of a cancerous tumor, yet the margin of the opening will be free, and not infiltrated. In the cystic tumors of the breast this clinical fact is easily perceivable. (Fig. 406.)

Simple tumors, by expanding parts, cause the cellular tissue around to become condensed, and form a capsule; consequently, most of the innocent tumors are encapsuled more or less completely. With the majority of cancerous tumors, however, a very different condition has to be described, for a cancer has the peculiar property of freely infiltrating all the tissues upon which it presses, at its base, round its borders, and upon its cutaneous aspect. As the tumor approaches the surface, the integument first appears to be drawn down to it, and afterwards seems as though glued to its surface (Figs. 399, 400). At a later stage, the skin becomes infiltrated with cancerous elements, feeling to the finger firm, fibrous, or tuberculated; and when ulceration has commenced, the edges of the skin are palpably indurated, thickened, and infiltrated with cancerous products (Fig. 405). The contrast between these different conditions of integument in the two classes of tumors is most marked and very important, forming a very valuable means of diagnosis in the extreme stage of simple or malignant tumors.

Simple or innocent tumors affect the patient solely through their local influence. They grow by their own inherent properties, irrespective of the growth of the parts in which they are placed; have little disposition to soften down or ulcerate, and no tendency to multiplication in other tissues, or to involve the absorbents with which they are connected. Cancerous tumors not only affect the patient through their local influence, but have a marvellous tendency to multiplication in any part of the body. Through the lymphatic system they involve the glands of the part with which they are connected, while through the vascular system they spread to other parts. They are prone, also, to degenerate and ulcerate.

When simple tumors are multiple, they invariably are found in the same tissue. When cancerous tumors are multiple, they are mostly found in different tissues. Thus, amongst the innocent growths, multiple fatty tumors of the skin are not uncommon; multiple fibromata of the uterus are often seen; multiple glandular tumors of the breast are met with involving one or both organs; and there are records of multiple fibroplastic or myxomatous tumors. It is not seldom that multiple enchondromatous tumors and exostoses are seen; but in all these instances the tumors occupy one tissue.

In the cancerous multiple tumors no such description can be given, for they spread in ever widening circles from the parent tumor, the cancerous elements spreading locally in connective tissue as freely as the floating blood-cells move through the walls of the blood passages, as a colloid is penetrated by a crystalloid, wandering about in what are called solid tissues. They follow the course of the lymphatics and affect the glands, and at times seem to follow the course of the venous circulation. They recur by continuity of tissue as from constitutional reproduction, and Mr. Moore, in his work on 'Rodent Cancer,' has referred to a case of Mr. De Morgan's, in which, from a cancerous tumor within the skull, some detached fragments, which had sunk in the fluid of the arachnoid, adhered to the spinal cord and grew. They spare no tissue or organ, but invade one and all, without order or law, in their destructive objectless growth.

All tumors cannot, however, be divided into the *innocent* and the *malignant*, for there are some of an intermediate kind which in structure approach the innocent, but in habit the cancerous, as they *recur* after removal. They have consequently been called *recurrent* tumors; but, as the habit of recurrence is not the only point in which they approach the cancerous tumors, it is perhaps better to term them *semi-malignant.*

I propose, therefore, to describe tumors under three headings:

1. Innocent;
2. Semi-malignant, or recurrent;
3. Malignant.

I. INNOCENT, OR NON-MALIGNANT TUMORS.

These may be divided into the "*Cystic*" and the "*Solid,*" the cystic under certain conditions becoming solid by the development of intra-cystic growths.

Cysts are developed in many ways:

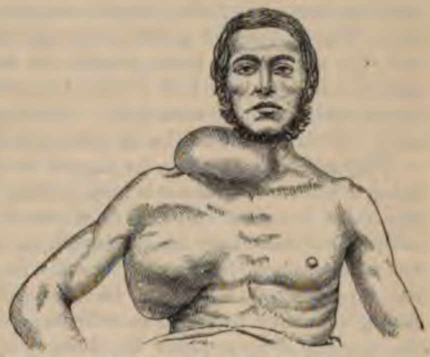
1. Some are possibly new growths or largely developed cells, having an independent life and being capable of secreting their own contents, or producing solid growths;—autogenous cysts, as Sir J. Paget calls them.

2. Some are formed in an accidental way by the simple effusion of fluid into the spaces of connective or other tissues, the walls of these *false cysts* gradually consolidating, as is commonly seen in bursæ and in ordinary tumors.

3. Others, again, are produced mechanically by the dilatation of occluded ducts or natural gland-orifices, the cyst enlarging by the secretion of the ducts or gland contents. Of these the mucous cysts of the mouth and vagina, the sebaceous cysts of the skin, and the milk cysts of the breast, are the best examples. Virchow calls these cysts by retention.

In many cases, however, it is impossible to ascertain how the cysts are formed.

FIG. 16.



Serous cyst of the neck. (Birkett's case.)

Serous cysts are most commonly found connected with one of the vascular glands of the body, as the kidney, ovary, thyroid, or breast, but they are not rare in the connective tissue, and are found even in bones. When seen in the neck they are described as "*hydroceles of the neck.*" Some of these are congenital, but the majority occur later in life. They appear as single or multilocular cysts, made up of thin membranous walls, lined with pavement epithelium. Like a serous membrane they contain a limpid, watery, or tenacious highly albuminous fluid, more or less stained with blood, occasionally holding cholesterine in suspension. These cysts are found in the neck, anywhere between the lower jaw and clavicle, beneath which they at times pass (Fig. 16); they are usually deeply seated, and occasionally superficial; they give annoyance only from their size, and are painless; when inflamed, they may suppurate. They are recognizable by their globular cystic form, soft fluctuating feel, and painless increase.

These cysts are not to be confounded with those of the *thyroid gland*, which are far more common, and at times attain a large size, growing as quietly and painlessly as do the cervical. Usually, however, they have thicker walls, are more tense, and are commonly multiple; moreover, they move up and down with the gland on deglutition. Their contents are more viscid and frequently mixed with blood in variable proportions; indeed, some of these thyroid cysts are *blood cysts*, which when tapped would go on bleeding if allowed, even to the death of the patient. I have recorded such a case ('Guy's Reports,' 1864). It is probable, as Sir J. Paget has suggested, that many of the cervical cysts are thyroid in their origin, springing from some outlying portion of the gland.

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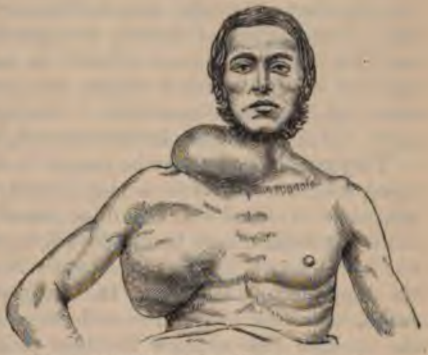


Serous cyst of the neck. (Birkett's case.)

These cysts are not to be confounded with those of the *thyroid gland*, which are far more common, and at times attain a large size, growing as quietly and painlessly as do the cervical. Usually, however, they have thicker walls, are more tense, and are commonly multiple; moreover, they move up and down with the gland on deglutition. Their contents are more viscid and frequently mixed with blood in variable proportions; indeed, some of these thyroid cysts are *blood cysts*, which when tapped would go on bleeding if allowed, even to the death of the patient. I have recorded such a case ('Guy's Reports,' 1864). It is probable, as Sir J. Paget has suggested, that many of the cervical cysts are thyroid in their origin, springing from some outlying portion of the gland.

Cysts are also found over the thyroid cartilage, but these mostly contain grumous blood, and rarely grow larger than half a walnut. In a case under my own observation, a cyst completely covered the thyroid cartilage, and was lost on either side in the deep tissues of the neck. It existed in an adult man as a soft fluctuating swelling, and had been growing for some years as a painless formation.

Cysts which are possibly bursal, are likewise found in connection with the hyoid bone.

TREATMENT.—Cervical cysts had better be left alone, unless from their size they require surgical treatment, because there is always danger in dealing with any deeply seated cyst in this region from the liability of subsequent diffused inflammation of the cellular tissues of the neck. I lost a patient, some years ago, from this cause, after simply tapping the cyst.

When surgical treatment is called for, *palliative* means had better be primarily adopted. This treatment consists in merely drawing off the contents of the cyst by means of a trocar and canula, or the "aspirator." Should the fluid re-collect rapidly the operation may be repeated. In performing this operation the surgeon must guard against puncturing any of the superficial veins or deep vessels, and should recall their position before puncturing.

Should these measures fail even after several repetitions, the best practice is to introduce into the cavity of the cyst a drainage tube made of perforated India-rubber. When the tapping has induced some suppurative action, the opening may be enlarged and the tube inserted, but when the cyst is large it is well to pass the tube completely through it. This may readily be done by means of a long trocar and canula, such as that employed for puncturing the bladder per rectum, the pilot trocar being introduced into the cyst after it has been opened at a dependent point, and then made to traverse the cyst, possibly beneath the sterno-mastoid muscle to the opposite side. The pilot trocar should then be removed, the drainage tube passed through the canula, and the canula taken away, the two ends of the tubing being fastened together to prevent its slipping out.

I have treated many cases of deep cervical cysts in this manner with success. The great point to attend to is the free escape of all pus and cyst contents; if air gets in, let the opening be free enough for it to pass out. Should fetor appear, the cyst should be washed out daily with iodine lotion, Condy's fluid, or some other disinfectant. As the cyst contracts, the tube may be removed, but so long as any cavity remains, it should be left. The passage of a seton through the cyst is another method which may be adopted, and this is probably more suitable for small than for large cysts. Injecting the cyst with iodine is a third method which has proved successful, though it is as dangerous as any other, and not more successful. Extirpation of any large cervical cyst is a plan of treatment which should not be entertained, it is fraught with danger and difficulties.

Thyroid cysts may be tapped in the same way as the cervical, this simple operation being often successful for a long period, and at times permanently so. When more active treatment is called for, the injection of one or two drachms of the compound tincture of iodine or alcohol may be employed, according to the size of the cyst. When a *blood cyst* has been tapped, the flow of blood will usually cease on the removal of the canula; and the tapping may cure it. In the cysts over the *thyroid cartilage* a puncture may be made, but when the fluid re-collects or is of a grumous kind, an incision into the cyst in the median line appears the best practice. I have done this on several occasions with success, leaving a very slight scar. The treatment of cysts and tumors of the thyroid will, however, receive attention in another chapter.

The student should remember that nævi, when they degenerate, commonly show cysts in their structure (Fig. 141); these are, however, usually clustered together in a cutaneous or subcutaneous group. When they appear in the neck they might be mistaken for one or other of the cysts already alluded to. This mistake will be prevented by remembering the fact that they do occur, and by the history of the case.

Mucous cysts are found wherever mucous glands exist, and are caused by some obstruction to the escape of the gland contents. They contain highly tenacious mucus-like liquid albumen. They appear on the mucous membrane of the lips as *labial cysts*, and are small, tense, globular, painless swellings. They are found within the cheeks, upon the gum, particularly of the upper jaw and antrum, and very commonly beneath the tongue, as *sublingual mucous cysts*. Such cysts have been usually described as cases of "*ranula*." They are now known to be due to obstruction of the ducts of Rivini's mucous glands, and are not necessarily connected with the salivary organs (Fig. 191). Such a cyst may develop about the larynx, and cause obstruction, and such has been found in the œsophagus. They are common also in the labia pudendi, and also in the vagina. As *labial* and *vaginal mucous cysts* they appear as tense, globular tumors beneath the mucous membrane of the parts. I have seen them as large as an orange. These cysts generally contain thick, ropy, mucoid fluid, of a colorless or slightly yellow tint. Occasionally the fluid, too, is mixed with blood in different proportions. I have seen them contain black, milky, or coffee-ground fluid. Sometimes they inflame and suppurate, and run on into abscesses.

TREATMENT.—Small labial cysts may often be turned out as a whole on dividing the mucous membrane over them, but the sublingual and larger vaginal cysts, as a rule, cannot be thus treated. A free opening into them, and the introduction of a good plug of lint soaked in iodine to excite suppuration, may at times suffice, but not always. In the so-called ranula it may be tried before other practice is attempted. In the sublingual, labial, and vaginal cysts, I have for some years been in the habit of seizing the upper surface of the cyst with a pair of forceps or tenaculum, and cutting it off with scissors, thus freely exposing the deeper wall. In the sublingual this practice is, as a rule, successful without further treatment, but in the labial and vaginal cysts I have in addition generally destroyed them by the application of some caustic, such as nitrate of silver, to the exposed surface, after which the wound will granulate healthily.

When these cysts can be excised the operation may be performed. They must be destroyed or the secretion will go on.

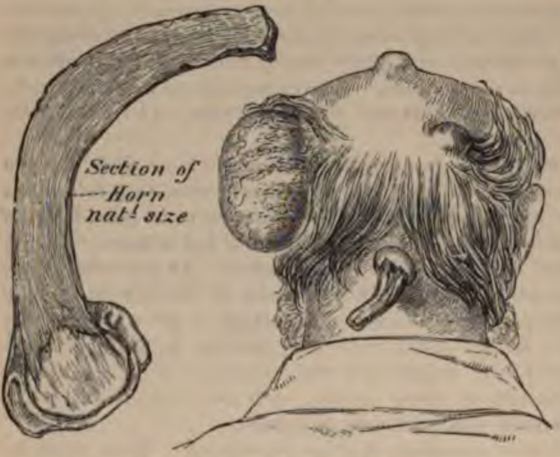
The mucous cysts of the antrum and upper jaw will be described amongst the tumors of the jaw.

Cutaneous sebaceous cysts, as they come under the notice of the surgeon, appear as "*congenital*" and "*acquired*" tumors. They are analogous to the mucous cysts, the glands of the tissue being in both instances at fault. Some are doubtless caused, as first described by Sir A. Cooper, by the obstruction to the orifice of the sebaceous glands of the skin, for this occluded orifice may often be seen as a small depressed black umbilicated spot upon the tumor; the contents of the cyst may often be squeezed through this orifice, or into it a probe may be passed. In a larger proportion of cases, on making an attempt to raise the skin from the tumor, a dimple or some evidence of connection between the two will be visible, thereby revealing its nature. But in other cases no such obstructed duct or even cutaneous depression can be observed; and although the tumor may be developed within the integument, it is probably a new formation, an adenoid or glandular skin tumor.

The **congenital** sebaceous tumors differ from those usually met with in the adult, or the acquired form, in that they are more deeply placed and mostly lying beneath the fascia of the part, occasionally beneath the muscles; they are rarely cutaneous. They are more common about the orbit and brow than any other part, the external angle of the eye being their favorite seat. They appear as small, hard, semiglobular masses deeply placed and are often, indeed, upon the bone. Cases, too, are on record, in which, by their presence, they have produced perforation by absorption of the bone. In the ear this result is not rare. These cysts are thin-walled, and often contain liquid secretion; sometimes of a pearly whiteness, and not rarely mixed with hair. I turned a complete ball of hair out of such a cyst on one occasion, though usually the hairs are fine like eyelashes, and are mixed with the sebaceous matter. The contents of these congenital cysts are rarely offensive.

The **acquired** sebaceous cysts may be found on any part of the body that is covered with skin. They are more common on the head and face than elsewhere, two-thirds of all cases occurring in these regions: when on the scalp they are known as "*wens*" (Fig. 17). They are always surrounded by a cyst-wall, composed of fibrous tissue more or less dense, and which can always be seen after these tumors have been enucleated from their beds. In "wens," however, there is a marked peculiarity which demands some notice. "The chief peculiarity consists in a thick dense horny capsule, which is closely in contact with the fibrous envelope of the original gland. This horny capsule was formerly regarded as the cyst-wall altered by pressure, until Mr. Prescott Hewett demonstrated its true relations and anatomical structure in his lecture at the College of Surgeons. It is now clearly proved that when one of these sebaceous tumors is squeezed out after the division of the skin, the fibrous cyst remains behind. This cyst can be afterwards excised, and its structure is identical with that of all the others. But the construction of the horny capsule requires explanation. If carefully examined, it is found to consist of epithelium, layer upon layer, mixed up with sebaceous matter. Sometimes a solid mass of epithelium is formed, in other instances a cavity exists in the centre, filled with soft

FIG. 17.



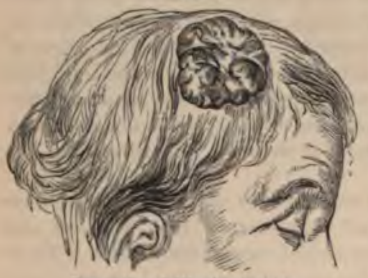
Sebaceous tumors in scalp, and horn.

sebaceous secretion. This capsule then seems to be a production of the epithelium of the sebaceous gland, which, being subjected to the pressure of the unyielding textures in which the tumor is developed, becomes converted by slow degrees into a tissue closely resembling horn or fibro-cartilage" (Birkett, 'Guy's Rep.,' 1859).

These sebaceous tumors are more frequent in women than in men, and are, beyond doubt, hereditary. Sir J. Paget says "they are certainly more commonly hereditary than are any forms of cancer."

Fungating and follicular tumors.—In neglected examples of sebaceous cyst the contents of the tumor may soften down, and, causing suppuration, may escape externally by ulceration. From the inner surface of the evacuated cyst a new growth may spring up, which, when forming an irregular, fungating, bleeding surface may at times put on an appearance which has been mistaken for cancer. On examining the edges of the wound, however, this mistake can scarcely be long entertained, as it will be at once observed that the edges of the wound are healthy, and not infiltrated with new matter, as would be the case in a cancer (Fig. 18). This fungating growth is really composed of exuberant granulations from the cyst itself. Abernethy recognized this when he said, "I have also seen after the bursting of an encysted tumor the surrounding parts indurate and throw out a fungus, forming a disease appearing like a cancer and which could not be cured." And "it is no uncommon circumstance to meet with wens that have burst spontaneously and have thrown out a fungus, which, like a fungous body, prevents the surrounding integument from healing." The best account of the affection is by Mr. Cock ('Guy's Rep.,' 1852.)

FIG. 18.



Fungating follicular tumor.

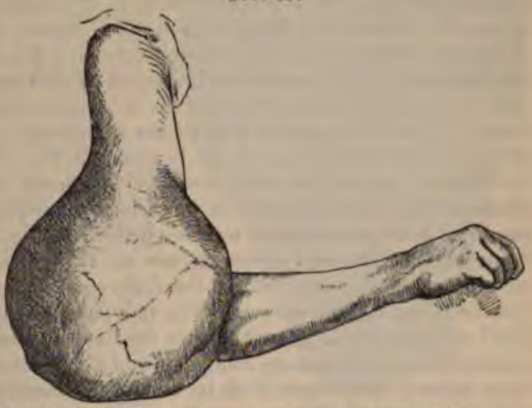
TREATMENT.—The only correct treatment of these cysts, whether whole, broken, or fungating, consists in their removal. In removing "wens," or *acquired* cysts, however, it is not necessary to be too careful in dissecting them out entire, the most effective method being to slit open the tumor with a bistoury and then turning it out with the forceps or handle of the knife; the cyst wall itself left is closely connected with the skin, but no harm follows. In the removal of sebaceous cysts from other parts of the body the capsule of the cyst should be taken away, while in the fungating tumor the whole ought to be excised. In the treatment of the *congenital* tumor it is always better to try and dissect out the cyst entirely; but nothing is more unsatisfactory than operating in such cases, for the cyst is always deep, its capsule thin and adherent, and any attempt to dissect it out, as a whole, is too often foiled by the bursting or puncturing of the capsule and the escape of its contents. When this occurs the surgeon must take away as much of the capsule as he can and then close the wound, a good result following, as a rule, though at times a recurrence of the growth will ensue.

The fear of erysipelas after these operations is really almost groundless. It may arise, but out of more than one hundred cases consecutively observed, I have not seen one example. Pyæmia may follow this as it does any other minor operation, but not more frequently. When patients are cachectic, such an operation of expediency as that for the removal of a "wen" had better be postponed, for under low conditions of health blood poisoning is likely to follow. Should, however, its removal be urged, this may be done by the injection into the cyst of some caustic, such as a few drops of deliquescent chloride of zinc, of carbolic acid, or the external application of nitric acid, or potassa fusa, to produce a slough through the skin, when the contents of the cyst may be turned or drawn out.

The dermoid cysts of the ovary are only of pathological interest, as are the dentigerous cysts of these parts. The dentigerous cyst of the jaw will be treated of in the chapter on diseases of the jaws.

Fatty tumors, otherwise called lipomata or steatomata, are very common. They are found wherever fat exists naturally in the body; and, as this material is more especially deposited in the integument, it is in and beneath this that fatty tumors are most frequently met with. They occur at all periods of life, from infancy to old age, and are even congenital. They attack the male sex as well as the female, but they are three times as common in the latter. They are generally single, but occasionally multiple. I have seen a case in which the whole integument was studded with them, and under these circumstances they are usually small. It is impossible to assign any valid cause for their development, hereditary and accidental causes having a doubtful influence. They are troublesome only from their position and the deformity they occasion (Fig. 19), and are at times the seat of pain, though such a symptom must be looked upon as an accident due to their position.

FIG. 19.



Fatty tumor of 37 years' growth on arm of woman, æt. 69.

These tumors are, as a rule, "encapsuled;" although in rare cases they are "continuous" or "diffused." This latter variety differs only from the former in that they are made up of smaller lobules of fat, and are more dense, while they are more common about the nape of the neck and face than the encapsuled variety; the large double chin being an example of the continuous lipoma, and congenital lipomata are generally of this nature. The encysted lipomata are most common on the shoulder, thigh, and trunk; some are deep-seated, as between the muscles of the limbs, or within the abdomen, or scrotum. Fatty tumors at times shift their position, that is, they drop downwards; several such cases have passed under my notice, in which the tumor has travelled some distance. Such an occurrence is peculiar to this form of tumor, and suffices to fix its nature.

The *diagnosis* is not usually difficult. If the tumor be deep a doubt may be felt, but, practically, the question is not of great moment, for it only refers to the nature of a simple growth, and not to its treatment. If subcutaneous, these tumors are lobulated and encysted, that is, are defined by a distinct boundary, their cyst-wall being formed by the condensed fibro-cellular tissue in which they are developed. To the hand of the examiner the tumor will feel more or less firm, and made up of lobes; when frozen by the application of ice it becomes harder. To the eye the tumor will, on raising it from its base and distending the skin, appear dimpled, and in parts the skin will be quite drawn inwards towards the new growth.

TREATMENT.—When no necessity exists for their removal they should be left alone. When large and unsightly, cumbersome or growing, they should be removed by excision. A single incision through the centre of the growth is the best and most expeditious method for turning the cyst out of its bed, which can be done readily by the finger. In dealing with the pendulous growths the whole should be cut off, leaving enough skin to cover the wound. After the operation the edges of the wound should be brought together by strapping and steady pressure should be applied; rapid union usually follows. Fatty tumors, when removed, very rarely return. Curling has recorded a case, however, in which a recurrence took place, but so much connective tissue was present in that example as almost to remove it from the class of lipoma ('Path. Trans.,' vol. xviii, 1867). I have also removed from the buttock of a lady a lipoma of two years' growth, the size of a fist, having removed from the same part a like tumor twelve years previously.

The "continuous" fatty tumor should never be removed unless under very urgent circumstances. The operation is comparatively formidable, so much dissection being required. In children, however, these tumors may be dealt with.

Fibrocellular and myxomatous tumors.—The term "*fibrocellular*" was originally given by Sir J. Paget in his classical lectures on tumors to a group of new growths or outgrowths made up of tissue more or less resembling the normal fibrocellular or connective tissue of the body, and the term "*myxoma*" has been applied by Virchow to the softer, looser, and more succulent or mucous variety of this group. Billroth calls this "myxosarcoma;" Müller collonema or colloid sarcoma. The typical *fibrocellular* tumor is firm, with a homogeneous surface on section, and bands of delicate filamentous white fibre tissue intersecting its substance. Microscopically these bands are composed of fasciculi of delicate fibres of connective tissue which freely interlace; while elongated corpuscles and nuclei, varying in abundance in different specimens, are found within the fibrous meshes. The tumor is more or less œdematous, serous fluid on section draining away. In the typical *myxoma* the tumor is less firm but more elastic than the former; its nature is far less homogeneous, and presents less well-marked interlacing fasciculi of connective tissue, and from the meshes of this tissue will flow a variable stream of clear, translucent viscid mucus. The fibres of the connective tissue are visible under the microscope, but in smaller bundles and more drawn out. Abundance of cells, also rounded, elongated, branching, and even anastomosing together with nuclei, will be found to fill the cavities formed by the confused network of delicate fibres of which the tumor is composed. The structure of the tumor, says Sir J. Paget, closely resembles the embryonic connective tissue, or the Whartonian jelly of the umbilical cord. Between these two extremes many intermediate varieties are found in practice, the cell or the fibrous elements predominating in different proportions with the viscid mucous secretion. In the myxomata, fat often forms an important element in its structure; glandular elements may also be found, their presence being determined by the position of the growth and the propinquity of a gland. Bone or cartilaginous elements are at times mixed with the others. The fibrocellular tumors are mostly outgrowths, the different forms of softer polypi and cutaneous pendulous tumors being of this nature. The polypi of the nose are the best specimens of the looser kind of fibrocellular growths, as in consistence they vary from a watery pellucid pendulous outgrowth to a firm, more compact, and fibrous tissue. They are, however, always covered with mucous membrane with its ciliated epithelium. The softer tumors of the antrum are also of the same nature, as are the mucous polypi of the uterus, bladder, and rectum. In the rectum the fibrocellular tissue is intimately mixed with the glandular elements of the part. Amongst the fibrocellular outgrowths of the integument those of the male and female genital organs are the commonest. The tropical elephantiasis scroti is of this class. The pedunculated outgrowths of the skin are also of the same kind.

Fibrocellular growths, as deep-seated tumors, are very rare. They do occur, however, in the connective tissue of the body, the intermuscular spaces of the thigh and arm being the commonest seat. They *are always surrounded by a capsule*, and, when not confined by unyielding parts, are more or less ovoid; at times they are lobed. They possess a smooth outline as well as an elastic feel; some of the softer kinds, indeed, give the idea of fluid. They are tumors of adult life, being rarely met with in children. They increase in size with variable rapidity, the amount of fluid they contain materially affecting this feature. The pendulous fibrocellular outgrowths, mucous or cutaneous, at times swell out and at others contract, while those of the skin appear shrivelled and loosely encapsuled. Those of the genital organs may attain a very large size, some which are on record having weighed as much as forty pounds. At times these tumors inflame, slough, or ulcerate in an indolent but in no way a typical manner.

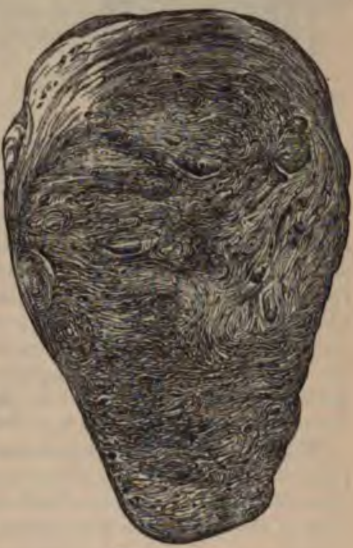
Myxomata are mostly soft, succulent tumors, made up of loose connective tissue, with more or less of their own special tenacious gelatinous secretion. They are not rare about the angle of the jaw, nose, breast, and abdomen. They are met with also in the extremities and in the eye, as well as in the delicate connective tissue of the nervous system, particularly of the brain and also of the nerves. When attacking the brain and nerves such growths are commonly found in the young; Virchow has named them *gliomata* (Fig. 30), the cells being of a small round or pointed form, embedded in granules and held together by delicate fibres. In some cases the fibre element approaches the firmer kind of fibrocellular tumors.

Treatment.—Excision is the only practice that can be followed; although this operation need not be performed when the tumor is small and not progressing, especially when it occurs in aged people. Good success usually attends the practice. In the firmer fibrocellular varieties, and in the firm myxomata, a return of the tumor is not to be expected, but in the softer myxomata, where cell elements predominate, the risks of a return are great.

Fibrous tumors—Sarcoma.—This term is applicable to the denser form of tumors or outgrowths made up of fibre-tissue or closely-packed connective tissue elements (Fig. 29). When mixed with the non-striped muscular fibre, the growth is known as "*fibro-muscular*," or as a "*myoma*" (Virchow's term). When associated with cysts, it is called "*fibro-cystic*," and when with calcareous matter "*fibro-calcareous*." These varieties are found chiefly in the uterus. Fibrous *outgrowths* or *polypi* are commonly met with in the uterus, pharynx, and occasionally in the rectum. They have been found in the intestine and other parts. Fibrous tumors are found likewise in the uterus and prostate, and *occasionally* in connection with the bones, periosteum, nerves and skin. In those about the bones the elements of bone or cartilage are usually found.

The fibrous outgrowths have no capsule, but are continuous with the tissue from which they spring, and are made up of fibre tissue more or less closely packed and arranged in bundles or in concentric circles; they are but feebly vascular. Those of the uterus are the most typical. (Fig. 20.)

FIG. 20.



Fibrous tumor.
Drawing 387^{82}, Guy's Hosp. Mus.

Fibrous tumors are always encapsuled, and have a tendency to assume an ovoid or globular form when not confined, but when compressed or bound down by surrounding parts, they take an irregular lobular shape. In structure they are very similar to the outgrowths.

Fibrous tumors are firm, and occasionally most unyielding. They are slow in their increase, and give pain only from their position. When bound down by a dense fascia or situated near a nerve they cause much distress. They only interfere with life or comfort mechanically. They are usually single, except in the uterus and when in connection with the nerves. As they come under the notice of the surgeon, those connected with the periosteum or bones, called *periosteal sarcoma*, are the most common, and of all bones the jaws are the most frequently affected by them. They are chiefly periosteal and appear as outgrowths (*vide* Chapter on Tumors of Bone). They are found in the pharynx, on the lobule of the ear, and on the nerves as "neuromata."

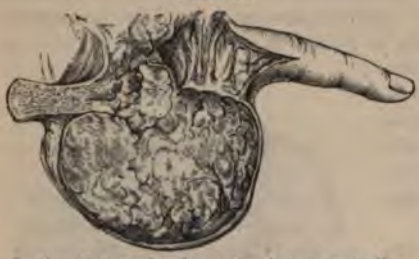
The **subcutaneous fibrous tumor** is a hard movable tumor beneath the skin. It is usually small, but when of a less dense kind and more nearly approaching the fibro-cellular tumor, it may attain a large size. Under these circumstances the skin will become part of the tumor, it will then often ulcerate and allow the growth to protrude through the opening and ulcerate or even slough, and thus these tumors sometimes bleed freely. At times fibrous tumors seem to grow from the deep fascia.

Excision is the only treatment which offers any prospect of success, and when these fibrous tumors are removed a recurrence is rarely met with. The fibro-muscular, fibro-cystic, and fibro-calcareous tumors are mostly uterine.

Enchondromata, or cartilaginous tumors, are most commonly met with in connection with bone; next in frequency they are found in the parotid or submaxillary regions, and are seen in the testicles, intermuscular septa, and other parts.

They appear, as a rule, in young subjects, in people under middle age, and are far more common, according to my own notes, in the female than in the male. They are usually slow in growth, the majority having existed years before the patient seeks advice. The instances of tumors of rapid growth on record are rare. These tumors, when not outgrowths, are always encysted, and have a smooth, tense, and elastic feel. In some examples they are uniform and even, in others bossy and nodulated; they rarely cause pain, and produce anxiety simply from their position and size. Those in the parotid or submaxillary region appear to grow superficially, and to be movable; but they often dip down deeply into the tissues, and considerable care is required in their removal; as often as not they are very adherent to the surrounding parts. These simple parotid tumors rarely involve the facial nerve or cause paralysis, as they do the cancerous tumors. When the cartilaginous tumors grow *within* bones they expand them into a thin shell.

Fig. 21.



Section of an enchondromatous tumor expanding metacarpal bone.

These cartilaginous tumors are usually innocent, and consequently only separate the parts between which they are developed. They never involve the integument by infiltration, but only stretch it; in exceptional instances they excite inflammation and ulceration in the skin, with subsequent perforation; they do not affect the system through the glands, although it must be added that rare examples are on record in which cartilaginous tumors have returned and affected the lymphatic system like a cancer. Sir J. Paget has recorded such an instance in the 'Med.-Chir. Trans.,' 1855, and De Morgan in the 'Path. Trans.,' vol. xx.

The section of a cartilaginous tumor is fairly characteristic (Fig. 21). It cuts crisply and presents a smooth surface; it may appear of one mass, or made up of many lobules. In some cases the consistence of the tumor is close, and is composed of translucent or bluish masses of fœtal cartilage, as is best seen in the periosteal forms. In others it is loose and granular, as in those expanding the bones. In many of them fibrous or glandular tissue is intimately mixed with the structure of the tumor, the parotid tumor affording the best type of this kind. In the cartilaginous tumors of bone, bone elements are always present; in those of periosteum, fibrous elements; and where glands are involved, glandular structure. When cartilaginous tumors soften down cysts are found, usually containing a dirty brown serous fluid, or simply filled with broken-down tissue and pus, or with a more tenacious synovial kind of fluid.

Microscopically, cartilaginous tumors present diverse forms, simple fœtal cartilage-cells, embedded in some cases in a hyaline or in a granular matrix, in others in a fibrous or glandular stroma, or even both in different parts of the same growth. The most typical form is that in which the cartilage-cells are grouped together in masses, surrounded by fibre tissue. From this type great deviations occur, the cells being, more or less, scattered between the fibres. In some instances the nuclei of the cells are free and numerous, in others they are filled with granules or oil-globules, apparently degenerating. Occasionally, the cartilage-cells are developing, and take on the mature form of bone-cells (Fig. 28).

Treatment.—The removal of the cartilaginous growth is the only efficient treatment, but the practice must be determined by the position of the growth and all the other points with which the tumor is clinically surrounded. When removed, a return rarely takes place. Cases, however, are on record (the Guy's Museum containing a few), in which a return ensued after a second or third excision, but such instances are exceptional.

The cartilaginous tumors of bone will be considered under the head of Diseases of Bone.

Osseous tumors naturally come to be dealt with after the cartilaginous, for the two elements are usually combined; and, as in the enchondromata, traces of bone may be found, so in the osseous tumors traces of cartilage may exist.

These are found in two forms, the *cancellous bony* and the *compact bony tumor*, better known under the name of ivory exostosis. The latter growth is peculiar to the bones of the skull.

The cancellous is almost always developed through cartilage, and made up of tissue precisely similar to the cancellous tissue of bone. In some cases it is covered with a thin casing of compact bone, like the cartilaginous tumor growing within a bone, but in most it is covered with a layer of cartilage, by the ossification of which it grows. A diagram illustrating these points will be found in the chapter dealing with exostosis, and the clinical aspect of the subject will be again considered in the chapter on Tumors of Bone.

Myeloid tumors are, as primary growths, always found associated with bone, either growing from the bone, as in "epulis," or more commonly in the bone, and when in this position usually in the articular end. The term was given to the class by Paget on account of the likeness between its cells and those of fœtal marrow. Lebert called them "fibroplastic," and Virchow "giant-celled sarcoma."

When these tumors are periosteal they have the clinical features of a fibrous growth; when within the bone, they appear as chronic expansions of the articular extremity or shaft. When large and so expanded as to have burst through their osseous case, they appear cystic and semi-fluctuating—even to the extent of [illegible] pulsatile. They are usually slow in their progress, and often painless, and it is fair to suppose that many of the cases of cystic expansion of the articular extremity of a bone are due to myeloid disease. The disease is one of youth and young adult life; and the growth is usually single. It is not connected with any cachexia or glandular enlargement, as happens with cancer, and when removed it rarely returns. Instances of recurrence, however, have occurred, and I have seen one. Sir J. Paget has recorded others.

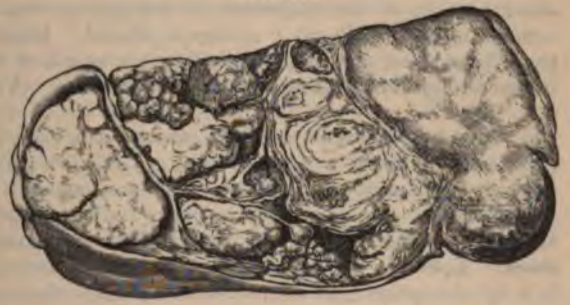
A myeloid tumor presents in section a peculiar appearance. It may be solid or cystic in variable degrees; osseous matter, fibrous matter, or fluid may exist in different proportions; yet in every specimen the cut surface will present blotches of a pomegranate crimson or of a darker blood color, these tints mingling more or less regularly with those of the other tissues.

Under the microscope the characteristic polynucleated cells are seen; these are large, round, or irregular cells, containing many, even ten or more, oval, well-defined nucleated nuclei floating in a clear or granular substance. They are found in masses or distributed throughout the tumor between the bundles of fibre tissue. They are diagnostic of myeloid disease. With these cells Lebert's caudate or spindle-shaped cells are also found (*vide* Fig. 29).

Glandular or adenoid tumors are new growths simulating more or less perfectly the gland structure in the neighborhood of which they grow, and are not hypertrophies of the glands, but distinct tumors. In the breast the usual innocent tumor of the organ is of this nature, and is called *adenocele*, but it is also found in the prostate, uterus, lips, tonsil, thyroid, and integument. They are not rare as lymphatic glandular tumors. Fig. 31 represents admirably the microscopical features of the adenomata as a class, and Fig. 22 the appearance of such a tumor in section, some parts being solid and others composed of pendulous intracystic growths.

They are generally growths of young life, and are found during the active period of a gland's existence. They are always encapsuled, and can usually be turned out of their bed with ease on dividing the capsule. They generally assume a rounded or ovoid shape, and are distinctly movable beneath the integument which is not involved. "On section," says Paget, "they commonly appear lobed, or intersected with partitions of connective tissue, and are pale, grayish, or yellowish-white; in some specimens looking translucent and glistening, in others opaque; in nearly all acinous or glandular. To the touch, some, especially the white and more opaque, are firm, tenacious, and elastic; others, especially the yellow and more glistening, are softish, brittle, slippery, and succulent, with fluid-like serum or synovia. Not rarely cysts are embedded in the solid growth, and these are filled with serous or other fluids like those which are found in the barren cysts of the mammary gland itself. In the labial and parotid glandular tumors portions of cartilage or bone may be mixed with the glandular structure; and sometimes—chiefly in the mamma—the glandular tumors appear as if formed wholly or in part of clusters of small sessile or pendulous growths, which fill cysts or partitioned spaces; thus they indicate their relation to the proliferous cysts, and suggest that they originated in such cysts. The textures around the tumor are usually quite healthy, altered only by displacement." These glandular tumors are often single, but at times multiple. Thus in the breast they may be many, and so loosely encapsuled as to move about as in a bag; in the lips they are commonly numerous; while lymphatic glandular tumors are almost always multiple. They grow with very variable rapidity, at times more slowly, at others with great rapidity. They require removal simply from the inconvenience caused by their mechanical pressure.

FIG. 22.



Adenoma of the breast, illustrating the pathological appearances of adenoid tumors.

To remove them it is only necessary to divide their capsule and the soft parts covering them in and to enucleate them. This need not, however, be done under all circumstances, for these glandular tumors not only cease to grow, but at times disappear; thus operative interference should only be entertained when the growths are large or increasing, or very painful. Medicine does not appear to have any influence in checking their growth.

The glandular tumors of special regions will receive notice in the different chapters devoted to their consideration.

Vascular and erectile tumors are considered in Chapter X.

Papillary growths, or tumors, require a brief notice. They are found in the outside or inside skin, and in the mucous membrane, while instances are on record where they were found on serous membranes. On the skin they occur as warts, cauliflower or sessile, and as condylomata. Some of the horny skin growths are of this nature. They occur in the mucous membranes as villous growths, and I have seen them on the hard and soft palate, tongue, rectum, and bladder. The two latter regions are indeed common seats of the affection. They seem to be a mere delicate outgrowth of subcutaneous or submucous tissue, with their natural epithelial covering, at times involving the gland structure of the part. They are usually innocent, though occasionally cancerous elements infiltrate the parts.

II. Recurrent or semi-malignant Growths.

It will have been observed that in nearly every group of tumors which has been described, recurrence after removal has been alluded to as a possible, although a rare, event. In this recurrence, too, the new growths approach in character to the malignant. In some cases, doubtless, the second tumor has been simply the external manifestation of a small one which existed when the original tumor was removed, or the increased growth of a portion of diseased tissue that was left—for the surgeon is often unable to perceive small tumors in excising the larger, as his incision leaves them unexposed. On two occasions, when removing a mammary glandular tumor, I have exposed a minute growth of a similar structure by the incision made through a portion of the healthy mammary gland to reach the principal growth. In both these cases had the small tumor been left a recurrence would have been recorded. In cases of recurrent fatty tumor, or of fibro-cellular tumor, it is highly probable that a small portion of the tissue was left. On one occasion, when I was enucleating a fibro-cellular tumor of several years' growth from beneath the fascia covering the scapula, I discovered two smaller growths which might have been overlooked and would certainly have grown. Nevertheless, it is a clinical fact that tumors, which are usually looked upon as innocent, occasionally recur; and the more the cell elements predominate in a new growth, the greater its succulence, and the looser its structure, so much the more prone is it to return. Each tumor, also, as it recurs generally becomes less solid, more succulent, and more rapid in its growth. With each recurrence the cell elements increase in proportion, and in all ways; "later formed tumors assume more of the character of malignancy than the earlier." All these recurrent tumors, named by Paget "recurrent fibroid," being usually composed of elongated, oat-shaped, caudate, nucleated cells, like the so-called "fibro-plastic" cells, which are found in granulation and embryonic connective tissue. Virchow calls them "sarcomata" (*vide* Fig. 29).

It must be observed that these tumors, as a rule, attack the young and healthy. They grow from a fascia or aponeurosis, are of slow growth, particularly at first, and destroy life only after many years, and from local causes. They return either in the spot from which they originally sprang, or from its immediate neighborhood. They simply affect the part mechanically, by separating and surrounding tissues, but never by infiltrating them. The skin is stretched over the tumor, but never involved in it; and if destroyed it is by ulceration from over-distension, while the absorbent glands are never secondarily involved, even in extreme conditions. Such tumors are to the hand more or less fibrous and lobulated, their fibrous feel being much influenced by their rapidity of growth. When cut into, they present a more or less compact surface, a clear serous fluid infiltrating its meshes; while even the finest microscopical section will be found tough and tenacious, and incapable of being pressed into a diffluent mass. Under the microscope they present an excess of nucleated cells and nucleated fibres, these, again, showing their tendency towards the characters of the malignant growth.

The treatment of recurrent tumors need not differ from that of the innocent, for as long as the disease is local, there is a reasonable hope that it will at last cease to recur after removal. "Sir J. Paget has known cases in which recurrence ceased for at least seven years after a fourth and a sixth operation; and after each operation the patient may expect to enjoy a period of comfort. Dr. Esmarch, of Kiel, stated to Sir J. Paget that he had seen cases of recurrent fibroid tumor cured, and not again returning, in patients who took large doses of iodide of potassium for several weeks. Generally, however, the prognosis of recurrent tumors must be unfavorable unless Dr. Esmarch's plan often proves curative. The ordinary course is that the tumors constantly recurring grow more rapidly, leave shorter intervals of health, protrude sooner, bleed and discharge ichor more freely, and affect deeper and deeper structures, till excision becomes too dangerous, and the patient dies exhausted." ('Holmes,' vol. i, ed. 2.)

III. Cancerous Tumors.

What is a cancerous tumor? Of what is it composed? and How can it be recognized? are questions which the student is constantly asking, and few are more difficult to answer with accuracy or precision.

Pathologically, a cancerous tumor is *not* composed of any definite or characteristic elements, such as at once stamp it as being a cancer. It does not contain any distinct cancer cells which mark its nature, as the cells, nuclei, and fibres, which enter into the formation of a cancer may all be traced in other and in innocent morbid growths. "But neither in tumors of innocent character, nor in natural tissue, do these elements combine in such variety as is common in a single cancer" (Moor). It does not appear, however, to be incorrect to assert, that the more the cell elements predominate in a growth, and the more they approach an epithelial type, the greater is the probability of its being malignant, and therefore cancerous; for the soft cancers, which are undoubtedly the most virulent, are made up almost entirely of cells and nuclei—only enough fibre tissue existing to bind and hold these cells together.

It has been already shown how the so-called innocent tumor approaches the malignant in some of its features; and it must have been observed that those which form the intermediate links between the innocent and malignant, structurally approach the latter, in having more of the cell elements in their composition. The fibro-nucleated and recurrent tumors exist as proofs of this.

But these points touch only the anatomy and not the symptoms of those growths; they do not assist the surgeon to ascertain before its removal whether the tumor be a cancer or not.

What, then, are the external and general symptoms by which this point can be determined? And here it must be premised that in making a diagnosis, the history and progress of the disease is at least as important as the physical characters of the tumor.

If a tumor be found in a part, *infiltrating the tissues* with which it is in contact, there can be little if any doubt as to its being a cancer, for no innocent growth infiltrates tissues —it only separates them. The question of infiltration of a part, or the mere separation of it, is most important, and is, doubtless, one of the most valuable means we possess for the purpose of a correct diagnosis (Fig. 402).

A cancerous tumor, however, does not always infiltrate a part, although an infiltrating tumor is almost always a cancerous one; for it may appear as a distinct and isolated growth, being then, in surgical language, described as tuberous (Fig. 403). What, therefore, are the symptoms by which a tuberous cancer may be known? And first of all, has the tumor itself any peculiarities by which its nature may be recognized? Unfortunately, a negative answer must be given to this question, for although it may not be unfair to suspect the presence of a cancer when the tumor does not present any of the special appearances or symptoms which commonly characterize the innocent growths, it can only be a suspicion, as many innocent tumors are often deficient in the special symptoms which, when present, readily attest their true nature.

A subcutaneous tumor, unconnected with the integument, with an irregular bossy outline, and of a firm, fibrous feel, will, in all probability, be of a simple nature, for these are not the characters of a malignant tumor; but another with a smooth uniform external surface may be either a simple or malignant growth. If, however, any adhesion or drawing in of the integument to the surface of the growth can be detected, or any immobility of the tumor upon the parts beneath, the suspicion of its being a cancer may be entertained (Figs. 399, 400, and 401); for I have already alluded to the tendency which the malignant tumor possesses to involve the tissues in its neighborhood, and have pronounced that this tendency does not belong to the innocent growths.

I proceed further to direct attention to another symptom, which, if present, is most characteristic of cancer; and it is a secondary glandular, lymphatic enlargement. If this symptom appears, the probabilities of a tumor being cancerous become very strong, as innocent and nonmalignant tumors are rarely, if ever, attended with enlarged lymphatic glands.

A distinct and isolated tumor, therefore, which does not possess any of the special characters of a simple growth; which is attended with some evidence of secondary affection or infiltration of the parts; and with which an enlargement of the lymphatic glands in its neighborhood exists, may safely be regarded as cancerous. It is, however, only in the early stages of the development of a tumor that a difficulty in diagnosis is usually felt, because, as a rule, in the long-standing and well-developed growth, the diagnosis is not difficult.

The soft and so-called medullary cancer is the form which is usually met with during young life. It generally makes its appearance suddenly, and often after the receipt of some blow or injury. It grows, too, very rapidly, presenting a surface which, as a rule, is smooth and uniform, or of a semi-solid and fluctuating feel, and with large full veins wandering across. It is recognized by its sudden appearance, rapid growth, and uniform surface, points very different from those which simple tumors present, innocent growths being generally slow in their development, and more marked in their outline. The cases of medullary or soft cancer run their course very rapidly, and destroy life within a very short period of their development.

Hard cancers are the affections of middle age and adult life. They grow more rapidly than the innocent growths, often not requiring more than a few months to establish their true nature; they seldom put on the external appearances of a simple tumor, and never exist without assuming features which are more specially characteristic of cancer, the implication of neighboring tissues and secondary glandular enlargements being the chief features.

A *cancerous tumor* has therefore these characteristics:—

1. The peculiar power of infiltrating every tissue as it encroaches upon it.
2. It spreads to the lymphatic glands of the neighborhood through the absorbents.
3. It affects the body generally through the vascular system, thus giving rise to secondary deposits, that is to say, to the development of similar growths in the viscera or remote parts, the lungs and liver being particularly prone to its attack.
4. It is liable to recur after removal.

Cancerous tumors have been variously described by authors; the *hard*, as scirrhous or fibrous; the *soft*, as medullary; the *open*, *bleeding*, *soft* cancer, as "fungus hæmatodes;" the *black*, as melanotic; *skin* and allied cancers, as epithelial; and *bone* cancers, as osteoid.

All have, however, the four special peculiarities that have been already described as characterizing the disease.

In these pages cancers will be treated of as scirrhous, medullary, melanotic, epithelial, and osteoid.

Scirrhous cancer is the most common. It is the usual form found in the female breast, and is seen in the testicle, tonsil, skin, bone, eye, rectum, or any tissue. It is the hard or fibrous species denominated "carcinoma fibrosum." When attacking a tissue either by infiltration (the most usual method) or deposition, it gradually encroaches upon the tissue; and when this is soft it causes its contraction as in the breast. The disease spreads outward, and soon takes possession of neighboring structures by infiltrating them. In this way it becomes gradually less movable, and at last fixed. No structures resist its influence; fat, skin, muscles, and bones becoming filled with cancerous elements as the disease progresses. It is said "to increase most on the side of the chief arterial supply, and in that towards which by lymphatics and veins its constituent fluids most easily filter." (Moore.)

Thus the lymphatic glands become enlarged, and these in their turn may press upon nerves, causing pain, or upon veins, producing œdema. But cancers have not the power of living like innocent tumors, but are apt to degenerate and die; and thus, after a time, a cancerous tumor may soften down in its centre and burst, or die as a whole and slough out, or its surface may ulcerate. But, whatever happens, the disease still spreads in the neighboring parts; indeed, after the sloughing of a cancerous tumor, this spreading action in the bed from which it has been enucleated seems to be more rapid. Thus, the death of one part of a tumor is seen with the rapid increase of another part, and in this manner the disease goes on encroaching upon and infiltrating and destroying all tissues in their turn, causing death either by exhaustion, hemorrhage, or some internal complication.

In some instances of cancer, the integument over or about the tumor, before ulceration occurs, becomes infiltrated with small, shot-like tubercles; such a tubercle in its early stage feels to the finger like a foreign body introduced into the cutis; and as this grows it appears as a distinct skin tubercle. No clinical symptom is more characteristic of cancer han the presence of these skin tubercles.

In other instances the whole integument becomes œdematous and brawny, in fact, nfiltrated with cancerous elements, this state betokening the most rapid form of cancer. This brawny condition of integument commonly follows venous obstruction from glandular enlargement, but at times it takes place before any such complication. In rarer cases the cancer withers, "atrophic cancer," the disease slowly progressing to a point and then disappearing by a gradual process. Thus, cancerous tubercles will appear and disappear; cancerous nodules will form and fall off by the contraction of their own fibres. In this way cancer may become cured, or so stationary as not to interfere with life. I have had a case under observation in which the disease existed for twenty-three years, and seemed still local. I have recorded another in which the disease lasted twelve years, appearing and crumbing away at times during that period almost to a perfect cure. Cancers display a very variable degree of growing or existing power; and there does not seem to be any condition of the patient or of the tumor which either favors or disfavors these properties.

Some have an apparent vigor of increase that is remarkable, whilst others show no such tendency. In many cases a tumor that has been quiescent for a long period will suddenly increase actively.

The same thing may be said as regards the *cancerous ulcer*. In the atrophic form this may be merely a superficial loss of substance on the surface of the tumor which may be covered with a scab or present a glazed or a very slightly discharging surface. In other cases the ulcer will show an irregular surface with an elevated everted edge infiltrated with new tissue (Fig. 25).

When a cavity exists, formed by the softening down of the centre of the tumor or the enucleation of dead tissue, the irregular outline of the cavity, the fetid semipurulent sanious discharge, as well as the ragged and infiltrated edge of the wound are characteristic signs of its cancerous nature.

In such cases a cachexia becomes visible, a pale, bloodless, haggard look of sorrow and suffering, brought on by pain, sleeplessness, and exhausting discharges.

Pain in the development of a cancer is a very variable symptom. In primary growths it is rarely severe, unless some nerve trunk be pressed upon, or the tumor is bound down by a tense fascia or is developed within a bone. Under all these circumstances the pain is constant, of an "aching or of a so-called rheumatic kind." In others, it is usually compared to an occasional dart of pain through the part.

As a sign of secondary deposits pain, however, is a valuable symptom; neuralgic pain following in the course of a nerve being enough to excite fear of some deep-seated secondary growth. Than this, no more valuable or reliable clinical symptom exists.

The *section* of a scirrhous cancer is generally attended with a grating sensation, the parts cutting crisply; it presents a *concave surface*, and yields on scraping a milky juice. The tumor has no defined margin, the diseased and healthy tissues, as it were, dipping into each other. The surface of the cut portion may be vascular or bloodless, and has a bluish-gray or streaked yellow aspect, according to the amount of cell or fibre elements entering into its formation, or to its progress towards degeneration; the yellow spots being indicative of degeneration. Occasionally cysts or rather cavities containing serum, blood, or broken-down tissues are found in the tumor, and, at others, creamy saponified masses of degenerated tissues.

The microscopical appearances of carcinomata are well shown in Fig. 32.

Medullary cancer, like the scirrhous, is either *infiltrating* or *tuberous*, and possesses, in a marked degree, all the cancerous peculiarities. It is, doubtless, only a form of cancer and not distinct from the scirrhous varieties; because both often coexist, and the growths which are secondary to the hardest primary cancer are generally the soft variety. Medullary cancer is, however, the special form that appears as a congenital tumor, and which attacks children and young adults, and may be called "the cancer of young life." These growths form very rapidly and run their course far more quickly than the harder kind. They increase so fast that they push away the tissues with which they are surrounded more like the innocent tumors which separate them; their capsules prevent that general infiltration of the parts which is observed in the infiltrating form. It is found, although rarely, in the breast, yet more frequently in the intercellular tissue, and about the periosteum and bones. It is the usual form attacking the eye, uterus, tonsil, testis, and ovary; the bones and cavities of the head and face appearing peculiarly liable to its inroads.

These soft cancers usually appear as deep-seated swellings, and when not bound down by fascia or connected with bone are rarely painful; but when so situated a gnawing pain or ache is a frequent concomitant. As they progress and become more visible, they may present either a nodular lobulated or a smooth and uniform aspect; but in either case the integument covering in the growth will be traversed by many very large and dilated veins; while in some instances the growth has a bluish congested aspect, as if filled with venous blood (Fig. 401). These tumors are often so vascular as to pulsate, and thus simulate an aneurism. Such a symptom, however, is mostly observed in those connected with bone.

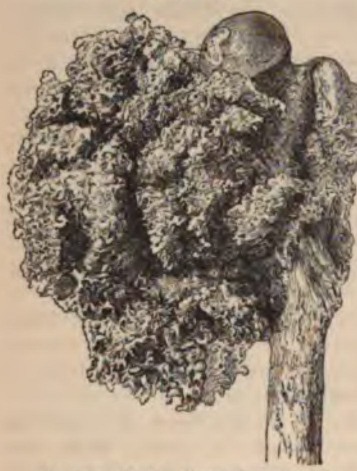
To the touch the swelling feels soft and fluctuating, often giving the idea of fluid, and should the surgeon, to satisfy himself upon this point, puncture the tumor with an exploring needle, blood will freely escape and with it some creamy tissue, which, under the microscope, will be seen to be made up of cells and nuclei.

When these soft cancers have burst through their facial envelopes they grow more rapidly, and when they have made their way through the skin they, as it were, pulp out, and project much as a hernia cerebri does after compound fracture of the skull. The soft succulent granulations and blood-infiltrated tissues that project suggested to Mr. Hay, of Leeds, the term "fungus hæmatodes." When a soft cancer is filled with blood it is known as a "hæmatoid variety."

When this form of cancer springs from fibrous tissue, or periosteum, it is often separated into sections by bands of fibres; and when it originates in bone, it may be similarly divided by thin plates or outgrowths of ossific matter; these plates or laminæ being sometimes distinctly separate, at others so closely packed together as to form something like a skeleton tumor (Fig. 23), the cancerous elements clothing the bony outgrowths or surrounding and covering them in. For diagnostic purposes the detection of these bony plates is of great value. Cancer may, however, attack bone in other ways (*vide* Chapter XXXII).

In cancer of the lymphatic glands these tumors develop to a large size. In the neck, axilla, and abdomen they appear when fully formed as fixed semifluctuating growths with the ordinary characteristics already described; and at first may be as movable as any gland. When they appear in the parotid region they usually if not always produce paralysis of the facial nerve; a clinical symptom I think I may say never found in the ordinary innocent parotid tumor; so that when present, this symptom is of value. As a rule, however, this soft cancer surrounds nerves and vessels without materially pressing upon them; large vessels and nerves being often found passing completely through their substance.

Fig. 23.



Cancer of bone. (Prep. Guy's Mus.)

The section of a soft differs from that of a hard cancer, as the "infiltrating" differs from the "tuberous" (compare Figs. 402 and 403); and differs also very materially in itself at different times. It may be firm or nearly fluid; white and creamy, or red and blood-stained. It may be soft from inflammatory action or degenerating from natural decay.

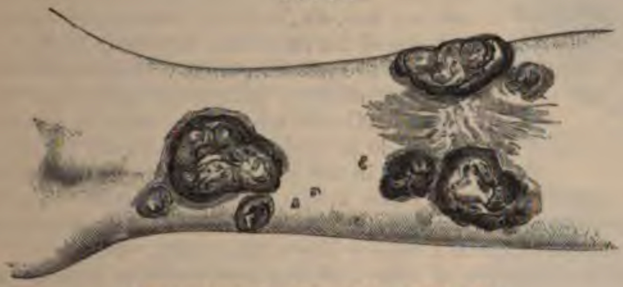
Under all circumstances, however, it will be divided into lobules; fibrous septa or fibrous envelopes separating these lobules from one another, as the fibrous capsule of the parent growth separated it from the other tissues.

The material composing these cancers, says Paget, "is a peculiar, soft, close-textured substance, having very little toughness, easily crushed and spread out by compression with the fingers. It is very often truly brainlike, most like fœtal brain, or like adult brain partially decomposed and crushed. Many specimens are, however, much softer than brain, and many, though of nearly the consistence of brain, are unlike it, being grumous, pulpy, shreddy, or spongy, like a placenta with fine soft filaments. Very few have a distinct appearance of fibrous or other regular structure."

These tumors when pressed or scraped yield abundant "cancer juice," and such juice is generally diffusible in water. No better rough test, says Paget, exists for the diagnosis of medullary cancers than this. The stroma of this cancer element is filamentous, and more or less condensed; it is also generally very vascular. The cell element always predominates, but the cells in no way differ in character from those found in the fibrous or scirrhous form. They are, however, less closely packed together, and seem to be suspended in the juices of the growth or inclosed within its delicate connective tissue (Fig. 32).

Melanoid or melanotic cancer is essentially a medullary cancer containing pigment, having its origin in a natural tissue, as in the choroid of the eye, or in a mole, in which pigment exists; but what it is that determines the development of these growths in tissues that have had a lifelong existence remains to be explained. The black cancers have, however, one peculiarity, and that is in their tendency to multiplicity. In this they are often most remarkable—the skin and subcutaneous tissues at times become studded with melanoid growths of all sizes and shades and colors. Fig. 24 is taken from a woman over whose whole body melanotic cancerous tumors were distributed, the disease having originated in a mole which I had previously excised.

FIG. 24.



Melanotic cancer. (From Model, Guy's Mus.)

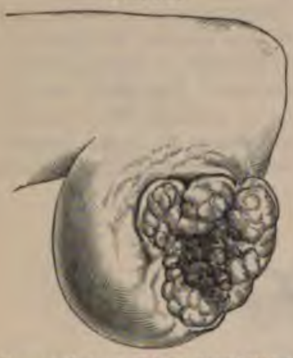
If it were necessary to adduce a forcible illustration of the fact that a cancer when first developed in a part partakes, in a measure, of the nature and peculiarities of that part, and even when repeating itself in the lymphatic glands and internal organs, still preserves the character which it originally acquired from the seat of its primary development, no better could be adduced than that derived from the natural history of primary and secondary melanotic growths: for a melanotic cancer always grows from a part which naturally contains pigment, and a mole is unquestionably its commonest seat, while pigment in some of its forms is almost always to be met with in all its secondary growths. It may be, perhaps, that the secondary glandular enlargements in their rapidity of growth, outstrip the tumor from which they originally imbibed their peculiar nature; nevertheless, their true character is maintained and preserved to the end. This cancer, as a rule, is of the soft or medullary form, and runs a very rapid course; an extreme example of melanotic cancer, indeed, presenting all the worst features of the other varieties. In rare examples of this disease the melanotic pigment may be found in the urine. (Fagge, 'Path. Soc. Trans.,' 1876.) It has, however, peculiarities of its own, to which attention will be subsequently directed.

The *osteoid cancers* will receive attention in the chapter devoted to the tumors of bone (Chapter XXXII). They are all probably only modifications of the medullary cancer affecting bone; although it may be mentioned that exceptional cases are on record where an osteoid cancer originated in some intermuscular interspaces.

Epithelioma and epithelial cancer are terms given to a form of cutaneous cancer from its similarity in structure to the epithelial elements of the natural skin. In the chain of malignancy, epithelial cancers are linked to the recurrent tumors, for they have both a tendency to return in a part after their removal, and to affect the system through the lymphatics; while in exceptional instances they may be found in the internal organs.

These tumors affect the skin or mucous membrane, and never originate in any other tissue. They possess this feature also in common with the more malignant cancers, in that they have a constant tendency to infiltrate the parts with which they come in contact, and do not, as innocent tumors, simply separate them. They are the common forms of cancer found in the lip, tongue, œsophagus, rectum, scrotum, penis, clitoris, os uteri, vulva, &c.; and may be described as the cancer of the skin, while in sweeps it is known as the "chimney sweep's cancer." Epithelial cancer is essentially an infiltrating disease; it is not, as the sebaceous, fatty, fibro-cellular, or fibrous tumor, a distinct growth developed in the tissues and separating them, but it is from its very beginning an *infiltration*. It begins, as a rule, in a wart or tubercle, which grows; it may fungate, crack, fissure, or ulcerate, and when this latter stage has been arrived at, its true character will at once be observed by the careful examiner, as the integument forming its base and margin will be evidently infiltrated with the cancerous material, presenting the well-known raised, indurated, and everted edges (Fig. 25). These appearances form a marked contrast to the condition of the integument which in an innocent growth has been ulcerated or ruptured by overdistension.

FIG. 25.

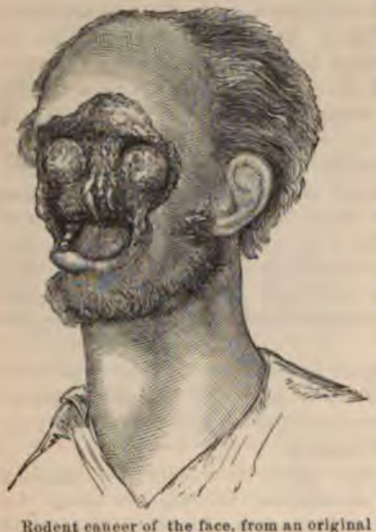


Cancer of stump, of two years' standing, from a man, æt. 58.

As a local disease, this epithelioma may progress slowly for years and cause little pain, inconvenience, or injurious effects; five, six, eight, or even fifteen years having elapsed in some of the cases that have been under my notice before advice was again sought, and it may continue for many years before it affects a patient in other ways than by the local disease. On the other hand, when it once begins to spread, it may do so rapidly; after removal it may return at once, not only in the parts, but in the lymphatics of the district, and even in the internal organs. When it spreads locally, it may, as a cancer, infiltrate and invade every tissue which it reaches. I have seen it more than once originate in skin and end in a total destruction of a bone ('Guy's Hosp. Rep.,' 1875).

Epithelial cancer is made up of cells, differing but little from those of ordinary epithelium, though they are grouped very differently, infiltrating the tissues in which they are placed or clustered together in masses, these masses being described as "nests."

FIG. 26.



Rodent cancer of the face, from an original drawing of Sir Charles Bell's, contained in the museum of the Middlesex Hospital, and recognized by Messrs. Shaw and Campbell de Morgan. It was introduced to my notice by my friend, Mr. Henry Morris, of the Middlesex Hospital, and kindly placed at my disposal by the Museum Committee of that institution.

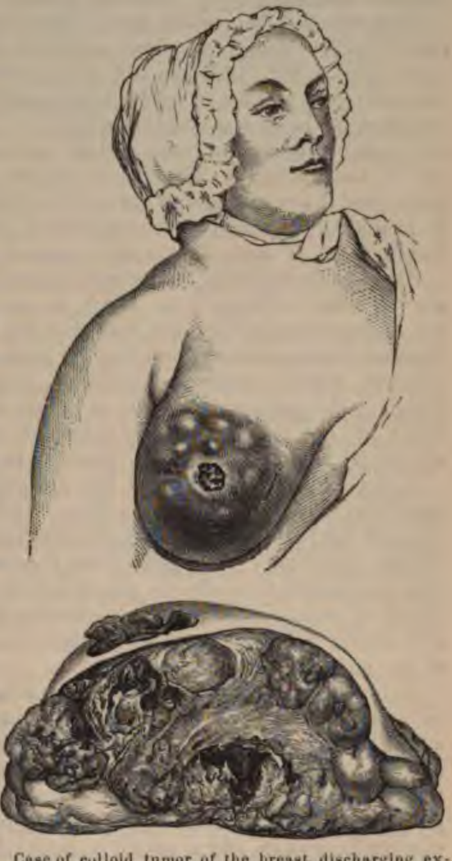
The surface of an epithelial cancer may be dry and warty, or ulcerating; when ulcerating, it will be, like all cancerous sores, irregular, and will discharge a thin or a creamy fluid. The edge will always be thick and elevated, like a wall of new tissue built up between the healthy and diseased structures. When the disease spreads it will invade and infiltrate every tissue, forming deep evcavated sores. It may involve the lymphatic glands like any other cancer, and these glands may soften down, and give rise to a cancerous abscess or an open sore. It usually destroys life from local causes, and not from secondary infiltration of the viscera, such a consequence being quite exceptional.

These cancers should always be removed, and the sooner this is accomplished the better the prospects of a cure or of a long reprieve, for if any cancer has a local origin the epithelial has, and if it be removed before any glandular enlargement has taken place the prospects of a good result are great. Sibley ('Med.-Chir. Trans.,' vol. xlii) made out from the Middlesex Hospital records, that epithelial cancers, on the average, destroyed life in fifty-three months, while scirrhous lasted but thirty-two. When removed by the knife, care should be taken to cut well free of the disease, for it is not unusual in this, as in all cancers, to find the tissues around the tumor sparsely infiltrated with cancerous elements, which, if left, would cause a return of the tumor. The same advice is applicable when caustics are employed.

In many examples of this form of the disease the removal by the galvanic cautery is by far the best method of treatment we possess, either as a cautery applied to the surface, or as a wire écraseur applied around the base.

Rodent Ulcers are closely allied to the cancers, and are more like the epithelial ulcer than the true carcinomatous form. Dr. J. C. Warren, of Boston, U. S., in an able essay upon this disease, asserts, that the cells of the rodent ulcer differ from those found in the epithelial by being smaller. They are local cancerous affections, and expend their force in destroying every tissue attacked, but they do not spread by means of the lymphatics or by secondary growths. They usually begin on some part of the face, head, or other locality as a dry wart, which, after it has shed many skins, begins to ulcerate. The ulcer then spreads slowly and regularly, with a border of new tissue raised as a wall, to separate it from the healthy parts; outside the border the parts are soft and natural, inside they are generally smooth, as an indolent sore, devoid of granulations, and glazed (Fig. 26). There is little discharge from these sores when superficial, but when they are extensive, and have dipped down deeply into other tissues, this is not the case; and when they inflame, they discharge a fetid ichorus pus. They seem to attack healthy as well as feeble subjects, and have little effect upon the general health until they touch vital parts. They appear after middle age, and are to be treated locally, by their destruction—cautery, escharotics, or scalpel being used, as seems most applicable. In local sores the knife, when it can be used, is probably the best instrument; but in others the galvanic cautery is unrivalled. In lieu of this the actual cautery may be used, and next to this, escharotics; "the caustic burns through the entire depth of the solid disease, and upon the casting of the subsequent slough, cicatrization is rapidly completed."—*Moore.* Chloride of zinc, potassa fusa, Vienna paste, or acid nitrate of mercury may be applied; the zinc rubbed down in a warm mortar with equal parts of fresh plaster of Paris is probably the best, because it destroys and dries the tissues.

FIG. 27.



Case of colloid tumor of the breast, discharging externally, in a woman, æt. 65, with section of the same.

Colloid cancer is hardly recognized as a special disease, for the term "colloid" is applied to tumors made up of intercellular spaces of variable sizes, filled with a clear glairy fluid like glue, which contains abundance of granules, and large nucleated cells (Fig. 32). The clinical history of some of these growths is that of an innocent tumor, whilst in others it is that of a cancerous nature. Colloid tumors are found in the breast, parotid region, ovary, rectum, and intestinal canal. It being known in this last region as the alveolar or gelatiniform cancer. Their true nature is not yet fully understood.

In the case Fig. 27 the patient was 65 years of age, and the disease had been growing for two years. The tumor occupied the outer portion of the gland, and had burst the skin covering it in. The colloid growth projected through the opening, the margins of which, however, were not infiltrated with disease. There were no enlarged axillary glands.

Villous growths may be cancerous as well as benign. When made up of cell-elements their cancerous nature is to be suspected, but the fact is only to be discerned by the clinical career. The nature of villous and colloid disease has been very ably discussed by Mr. Sibley, in the 'Med.-Chir. Trans.,' vol. xxxix, and 'Path. Trans.,' vols. vii, viii, and ix.

THE CAUSES OF CANCER.

These are most obscure. *Local injury* at times appears to have a very marked influence in determining the seat of a cancer, yet only in exceptional cases; one of such occurred to me recently in the case of a boy, æt. 18, who, after an injury to his right spermatic cord, in a few weeks became the subject of a pelvic tumor, which rapidly grew, and eventually destroyed life by obstructing the rectum as well as the ureters. After death the tumor was found to have been cancerous, having originated apparently in the right or injured cord, spreading downwards along the vas deferens to the base of the bladder, and subsequently ascending from the pelvis, above the level of the umbilicus.

Hereditary influence has always been considered as a very decided cause, still in how small a proportion of cases can any such be found? Sir J. Paget traced it in one out of every three; Mr. Sibley in one out of every nine; and in 222 cases of my own, it was traceable only in one of every ten instances. In many other affections, even the most innocent, as large a proportion might be found. In fatty tumors and in deformities, all surgeons recognize the frequency of an hereditary history. Indeed, looking at cancer as one of many diseases, there is no reason for regarding it as more hereditary than any other, and I am inclined to agree with Mr. De Morgan when he said "that all that could be said with regard to the constitutional nature of cancer applied equally to the constitutional nature of any, the smallest, growth that can be found in the body."

Striking examples of the hereditary nature of cancer are met with in practice, but they are not more striking, if so much so, as the hereditariness of growths of a simple kind. Sir J. Paget has pointed out, however, that when a local disease or deformity is inherited, it passes from progenitor to offspring in the same tissue, if not in exactly the same place, whereas, when a cancer is hereditary, it may break out anywhere. "The cancer of the breast in the parent is marked as cancer of the lip in the offspring. The cancer of the cheek in the parent becomes cancer of the bone in the child. There is in these cases absolutely no relation at all of place or texture."

Cancer is a disease of adult life, although it may attack a fœtus in utero, or an infant soon after birth ('Guy's Hosp. Rep.,' 1875), but when it does affect an organ in the full vigor of its functional activity, it partakes of that activity and runs its course with marvellous rapidity. In a general way, however, cancer is most prone to attack an organ that has passed through the active period of its existence and is degenerating, as in the breast or uterus. Sir J. Paget describes it as being "essentially a disease of degeneracy," and asserts "that it increases in frequency in proportion to the number of persons living as age goes on."

Cancer appears to be in its origin a local disease and to become general either by the influence of the juices of the primary tumor exercising an impregnative, spermatic influence (Simon) upon other parts, or by dissemination of its elements. This dissemination at first may radiate from its local source, and at a later period may become general through the fluids of the body; the secondary growths will partake largely of the characters of the primary, thus the osteoid cancer will propagate osteoid, and the melanotic melanosis, each cancerous growth, like a parasite, growing at the expense of the tissue in which it lies. Moore, in his work on 'The Antecedents of Cancer,' and De Morgan more recently have, I believe, established this fact. From a clinical point of view this is, without doubt, of very practical significance, for surgeons now admit, that the earlier a cancerous tumor is removed, the better are the prospects of a cure, or, at least, of a long immunity from the disease.

Treatment of Cancer.

The *general treatment* of cancer resolves itself into the improvement of the general health, the nutrition of the body by hygienic means, good nutritious diet, and tonic medicines. No medicine has any special influence on the disease.

The *local treatment* may be summed up in the word removal, for all cancers should, if practicable, be taken away as soon as their true nature has been established. In the early stage of a cancerous tumor, before the diagnosis has been made out, it should be protected from external injury, and from all irritating causes. No rough manipulation should be allowed, nor any movement of the muscles that surround or influence it. Warm or hot applications should be avoided, since it appears they encourage its growth. The most acute cancer of the breast I ever saw was one that originated as a chronic infiltration, and was made active by the application of hot fig poultices for a week. The gland itself and skin over it to the limit of the application became infiltrated to an extreme degree with cancer, which rapidly broke down, and destroyed life.

Moore used to think highly of the local application of the iodide of lead and opium ointment applied on lint to the tumor, and he believed it had some influence in diminishing and retarding its growth. Some have faith in iodine as a local application; but I must admit that I have never been able to discover that any of these or other applications had the slightest influence in checking the progress of cancer, and have consequently discarded them. When pain is present, the belladonna-extract rubbed down with glycerine into a fluid the consistence of treacle, or of the extract of opium similarly diluted, seems to be a valuable application. An opium or belladonna plaster spread on leather gives comfort and protects the part. The best protective application, however, is cotton wool.

When the diagnosis is established, the tumor should be removed, and the best method doubtless is, that of excision; delay being only justifiable when the general condition of the patient forbids the attempt. To delay is only to increase the risk of a local dissemination of the cancerous elements, and thus diminish the prospects of a successful result, giving time for the lymphatic glands to become enlarged, when removal of the primary growth becomes of less value; and to increase the chance of some internal or remote organs becoming involved, when operative interference is futile.

In removing a cancerous tumor the surgeon should not be too sparing of surrounding tissue; but when it is encapsuled there is no necessity for doing more than enucleating the mass. When it infiltrates an organ the only correct treatment is its removal, and in removing it care should be taken to cut away all skin that is in any way adherent to its surface, with as much of the surrounding fat as circumstances will allow.

When the tumor has been removed, all surrounding parts should be carefully examined, because it is not uncommon to find small cancerous tubercles in the connective tissue, fascia, or muscular sheaths, which if passed by unheeded would soon increase and give rise to a recurrent growth. It is from these points, indeed, that such recurrent growths probably often arise, and these, by care and observation, the surgeon may often prevent. De Morgan, after excision of a cancerous tumor, washed the wound with a solution of chloride of zinc, twenty grains to an ounce, in order to destroy the cancer germs. The surgeon, too, had better remove all skin, and allow the wound to granulate up, than save integument which is of doubtful integrity for the sake of making an apparently more complete operation. When lymphatic glands are enlarged and can be removed at the time of operation, they should not be forgotton; and they should be enucleated by the fingers or handle of the scalpel rather than be excised—their capsules ought to be divided and the glands turned out.

Cancerous tumors of the tongue, penis, clitoris, labium, neck of the uterus, etc., may be removed by the wire or chain écraseur, either with or without the cautery; but this part of the subject will receive attention in other pages.

When a cancerous tumor cannot be excised or the cutting operation is rejected, it may be removed by caustics; but such a method is more painful, slower, and not so successful as excision. When employed as a substitute for it, it is, like all substitutes, only second best; yet it is, however, often applicable where excision is not. The French surgeons do this by inserting around and into the tumor, thin conical flat wedges of chloride of zinc made into a hard mass with flour or plaster of Paris, holes being made into the tissue by the scalpel for the introduction of these flèches. Maisonneuve is the chief practitioner of this school. These "caustic arrows" of M. Maisonneuve are composed of wedge-shaped pieces cut from a thin cake of paste made by mixing one part of the chloride of zinc and three parts of flour with as much water as may be found necessary. These pieces or arrows are dried, and may be kept in a bottle for a long time without injury.

In England this plan finds little favor. The following method is more general: In a tumor that is not ulcerated let the skin be destroyed by the application of some strong sulphuric or nitric acid, and in this slough let one or more incisions be made; into which let a paste of chloride of zinc and flour mixed with the extracts of the Sanguinaria Canadensis, and stramonium, be introduced, fresh incisions being made through the thickness of the slough thus formed every other day, and fresh paste inserted. By this means the whole tumor may be destroyed or enucleated. The paste is a modification of that introduced into London by Dr. Fell of the United States, and is, without doubt, the best working caustic paste we possess. The following is the mode of its preparation: Boil down to a liquid extract some decoction of the Sanguinaria Canadensis, and, with an ounce of the extract dissolve a similar quantity of the chloride of zinc. Mix this with two ounces of the extract of stramonium, and the soft paste is ready for use.

Canquoin's paste is composed of chloride of zinc and flour in equal parts, a few drops of water being necessary to make it into a paste. A second form is probably better: Chloride of zinc one part, muriate of antimony one part, flour one part and a half, water a few drops. This paste is of the consistence of soft wax. At the Middlesex Hospital they use a paste made by mixing chloride of zinc and boiled starch with laudanum, till it reaches the consistence of honey.

When the tumor is ulcerating or open, no necessity exists for the primary application of a liquid caustic. The paste may be applied directly to the part, and fastened on by cotton wool and strapping; the thickness of half an inch applied for twelve hours usually produces a slough an inch deep.

Some prefer a solution of chloride of zinc alone inserted on cotton wool. M. Rivallié uses nitric acid applied on lint or asbestos; Velpeau, sulphuric acid on saffron. By some, the Vienna paste is preferred. Arsenic as a caustic has had its day, and is dangerous and less effective than zinc.

For cutaneous epithelial cancer the caustic treatment is the best. The chloride of zinc made into a paste with flour, or with sanguinaria, may be used if preferred. The potassa fusa is likewise a useful form. When the galvanic, or thermo- cautery can be obtained epithelial skin cancer may be readily destroyed. I have burnt down many such affecting the nose, cheek, eyelid, scalp, hand, arm, lip, and other parts. By it a large surface of diseased tissue may be completely carbonized and a healthy surface produced after the removal of the eschar. The operation should be performed with the aid of chloroform, and the whole thickness and edges of the diseased tissue destroyed. The after-pain is very slight, the cautery destroying all nerve sensibility. It is by far the best mode we possess of dealing with skin cancer, is more rapid in its action and certain in its results, besides being far less painful. When the disease extends it may be removed with the scalpel and the base of the sore cauterized. No more efficient mode of removing a skin cancer is within our reach.

The treatment of tumors by injection of fluids into their substance, as originally suggested by Sir J. Simpson, and more recently practised by Dr. Broadbent, has in it the elements of a successful plan, but has not yet been brought to any available state of perfection. Fatty tumors may be destroyed by the introduction into their substance of a few drops of deliquescent chloride of zinc, but cancerous tumors do not appear amenable to a like remedy. Dr. Broadbent believes that he has succeeded by injecting a liquid composed of one part of acetic acid and three of water; while Messrs. Moore and De Morgan assert that they have each succeeded by these means in obtaining gradual diminution of cancerous growths. I tried the plan in twenty cases, when it was first introduced, but never found any good result ensue. It was often very painful, and many patients refused to have it repeated, although they asked for the excision of the growth. More recently the injection of twenty drops of a solution of bromine dissolved in spirit, ♏v to ℥j, has had its advocates.

The treatment by pressure is of no practical utility.

By way of summary, it may be stated (I) that cancerous tumors should be excised when practicable, and the sooner the operation is performed, after the diagnosis is clear, the better. That removal by the écraseur is equivalent to excision.

(II) Open cancerous tumors, as a rule, should be treated by caustics, the best being those which contain chloride of zinc, or by enucleation.

(III) For skin cancers caustics are, as a rule, the most available, although excision in some instances, as in the lip, is to be preferred. The galvanic cautery, however, should be employed when possible, it being the most rapid and efficient destructive agent we possess.

THE MICROSCOPICAL ANATOMY OF TUMORS.

By Dr. MOXON.

Two distinct processes are observed in the construction of our bodies; the production of the elementary pieces, by whose compilation the fabric is composed; and the disposition of these elementary pieces into certain forms, whose shapes suit them to the requirements of the part to be made. These two processes differ as much as making bricks differs from building. Each of the tissues of which the body is composed has constructive elements peculiar to itself, and these elements are disposed in each tissue in a manner proper to that tissue. I need not instance examples, the fact is so familiarly true throughout physiological histology.

In the composition of the normal tissues the elements are fitted in form, size, and other characters for their proper use, and they are united together to compose structures which are adapted to their peculiar functions. We have no knowledge of the influences which induce the perfect adaptation we thus observe; but we can appreciate its necessity, since, without such fitness of the parts for their several duties organization and organized life would not exist.

Now when *morbid* growths arise in the body, do they show any constructive plan parallel to that observed in normal tissues? Is there any constancy in their elements, any weaving of these elements into structures? It is only of late years that an attempt has been made to answer this very interesting question by careful study and comparison of the minute anatomy of morbid growths. It has been found that the nature of the elements of those growths, and still more the kinds of texture they compose, serve usefully to indicate the tendencies and consequent dangers which constitute their clinical importance as tumors.

Surgeons were formerly aware that in the healing of wounds the new materials are made in the likeness of the parts which they adjoin. But this assimilation of newly produced matter to the nature of the tissue adjoining was regarded, so far as it was regarded at all, as in some way the effect of the adjoining tissue. The production of new elements and their employment in construction of organized forms were not traced out as distinct histological processes; nor regarded as showing an active vital power in the new substance itself. And indeed we need to distinguish these processes more plainly even in our own time.

When the microscope was employed upon tumors as a means of discovery, observers at first looked only to the elements which coarse microscopical examination could easily discover; and for a long while it was, and with some still is, the only question, what is the character of the component cells of the tumor? As if in the study of buildings one considered only what sort of bricks or stones they are made of. True, this would serve to divide them into brick, stone, concrete, and mud buildings, and we must not despise such an advance, which is a real step forward, in comparison with entire ignorance of structural composition.

But now we no longer confine attention to the component cells of tumors; rather in the study of them we have a main regard to the mode in which they are put together, and the degree and kind of organization which is undergone in the raising of them into often truly complex fabrics, such as we find many tumors to be when we properly comprehend their organization.

It will naturally be asked, do the pathological tumors evidence any new plan of building, or are they always on the plan of some natural type; is there anything new in the nature, or, if I may so speak, in the conception of any pathological tumor? The answer which has the greatest authority, that of the illustrious Virchow, on its side, is that there is nothing new in the plans of construction of tumors, but that all tumors are formed of substances natural to the body.

It has long been well known that a large proportion of tumors, especially those which show the most innocent disposition, have a structure like that of some healthy tissue. And this induced the naming of tumors after the tissue that they resemble, *fatty*, *fibrous*, *bony*, &c., or, as they are called, Lipoma, Fibroma, Osteoma (the termination -oma is now universally chosen to express tumor with structural resemblance to the tissue called by its prefix). Virchow's doctrine of the constant homology of every new tissue with some tissue natural to the body has induced him to carry this classification of tumors further than hitherto (unfortunately his book remains incomplete, and in some of the greatest difficulties the subject is still wanting his help). As a method of arranging tumors it is convenient; whatever may be said about his opinion, that no new substance can arise in the body. I believe that this opinion should be taken with due consideration if we would have a true view of the matter. Granting that whatever arises in the human body must be a human accident, so that feathers or cherry-stones will not develop in it, yet we must also see that the expression of all human accidents is not completed in the healthy man, but rather by elaboration and variation within him into something else, different, though still human. At any rate some intermediates between his healthy tissues might be expected. Many intermediates do positively arise which sufficiently show how wide a scope this possibility allows.

Indeed, it should be forcibly said that while those assumedly natural tissues found in tumors are really like the natural tissues of the healthy body in general description, yet they in all or almost all instances will be found to show differences in the building up of the elements, or even in the elements themselves, which make the common identification of them with the tissues they resemble rank only as a convenience, not expressing the whole truth of the matter.

So that I would lay down this proposition with confidence, that no morbid growth is ever found which has not in it sufficient peculiarity to distinguish it from all natural tissues, which peculiarity is to be looked at by those who would explain its characters and history; so that they should not exclusively regard those features it has in common with natural tissues. The practically important side of the matter is that osteoma is not bone and enchondroma is not cartilage, and lipoma is scarcely fat. Nevertheless, it is very convenient to be able to classify tumors by their structural *likeness* to the natural tissues developed or in course of development. Yet it is only in this sense as *like, but not identical*, that the grouping of tumors to correspond with the grouping of natural tissues is here practised.

Malignant: Cancer.—The question must be dealt with, what relation does the histological structure of tumors bear to the common clinical division of tumors into *cancers* (*recurrent*) and *simple* tumors, or into *malignant*, *semi-malignant*, and *benignant* tumors? We will shortly consider these divisions. Simple or benignant tumors are those that have no malignancy, and recurrent or semi-malignant tumors are those which have only a partial malignancy, so that the only *positive* question is what characters make a tumor malignant or constitute it a cancer?

Malignant.—In a very common yet vague sense the term malignant is applied to any fatal tumor, superficial or internal. There is no defence for this except from colloquial convenience. Fatal tumors certainly are not easily viewed as benignant or innocent. And hence arises the common use of the word malignant for fatal tumors, making innocency positive, and regarding all that are not innocent as deserving by negation the opposite term. But as I have said, malignancy is the active and positive thing to which innocency stands as a negative.

What are the active and positive characters and behavior of a tumor that get it the name malignant?

A tumor obtains the name with different authorities from two rather distinct points of view.

First. Paget, for instance, has regard to the *descriptive peculiarities* of the more destructive kind of tumors, and hence describes malignant tumors as follows:

"1. The intimate structure of malignant tumors is, usually, not like that of any of the fully developed natural parts of the body, nor like that which is formed in a natural process of repair or degeneration.

"2. Malignant growths may have the character of infiltrations; *i. e.* their elementary structures may be inserted, infiltrated, or diffused in the interspaces and cavities of the tissues in which they lie.

"3. It is, also, generally characteristic of malignant tumors that they have a peculiar tendency to ulcerate, their ulceration being preceded by softening.

"4. The softening that often precedes the ulceration of malignant growths can hardly be considered separately from the minute account of their structure. I therefore pass it by, and proceed to their fourth distinctive character, which is to be noticed in the modes of their ulceration.

"5. Malignant tumors are, again, characterized by this: that they not only enlarge, but apparently multiply or propagate themselves, so that, after one has existed for some time, or has been extirpated, others like it grow, either in widening circles round its seat or in parts more remote.

"6. A sixth distinctive character of malignant tumors is that, in their multiplication, as well as in their progress of ulceration, there is scarcely a tissue or an organ which they may not invade."

Second. Other pathologists regard rather the *vital properties* of the tumors which have been discovered as giving rise to those descriptive peculiarities which Paget enumerates; and hence say that a malignant tumor is one (1) which infects the neighborhood, by dispersing its offsprung elements in the tissue around, so that it (2) recurs after removal, because its seed was left; and (3) also extends to the lymph-glands along the lymph stream, and (4) to the great vascular viscera, or to points in the whole blood carrying system, by infection of the blood stream. In short, these pathologists reduce the word malignant into a compass which would be fairly expressed by such a bad compound word as auto-infectious.

Now, the compass of these two several lines of application of the word malignant is much the same. One describes what the other explains; the other explains what the first describes. If we are to decide which is the better, it must be settled by observing whether description or explanation most usefully determines the kind of a tumor. I think description must be widely and laboriously detailed to compass the expression of the signs of malignancy, and that the learner will scarcely carry descriptions which could fortify him against mistake. On the other hand, the conception of malignancy as auto-infectiousness is at once grasped, and, if discreetly used, will generally serve to give a sufficient clue to the nature of any given tumor.

Thus, as to any tumor of the breast, the inquiry, on one system, will be—"Does it push parts aside, or grow into them?" On the other—"Is the skin, &c., stretched over or involved in the tumor?" These questions, you see, amount to the same thing.

Again, on the one system the question will be—"Does the disease infect all through to the surface, and then open on it?" On the other—"Is the skin simply stretched, perhaps burst through, and does the tumor simply thrust out itself, while healthy skin awaits its chance to heal? Or, is the edge of the opening thick and everted, and callous with such and such an ulceration?" This, again, is the same question. But, repeating, as the student can, such ways of considering the characters of innocency, he will, I believe, soon learn to value the short comprehensive and comprehended grasp of them by the consequences of their auto-infectiousness, by means of which he can infer or explain the more tedious descriptive terms.

Cancer.—The word *cancer* is best regarded as the substantive which is equivalent to the adjective malignant, so that a tumor that is malignant is a cancer, and a cancer is a malignant tumor. If we accept this, there is no longer any need of discussing the compass of the word cancer; and, indeed, now and always, this has been the most ready and natural use of the word, and the one most universally employed. For if you watch the writing or speaking of any one who, priding himself on descriptive accuracy, limits the term cancer to carcinoma (p. 113), you will invariably find that before long he is using the word cancer as the equivalent of malignant.

On the other hand, the word cancer is made by some to be the equivalent of carcinoma; the latter having a limited application to a certain kind of tumor structure (See Fig. 32). Surely this is superfluous. The word carcinoma is enough for its proper application, and in pathological questions of precision, there is no hurry or vagueness to prevent the employment of four syllables. So I think the word cancer may be left to its colloquial wide signification as a malignant tumor of any sort, carcinomatous or otherwise. Certainly, tumors of various histological structure do prove auto-infectious or malignant. The tumors which most frequently show this malignancy are in order—(1) Carcinoma in all its forms, (2) Sarcoma, (3) Myxoma, (4) Lymphoma. Other tumors, also, are far from being free of the risk of auto-infection.

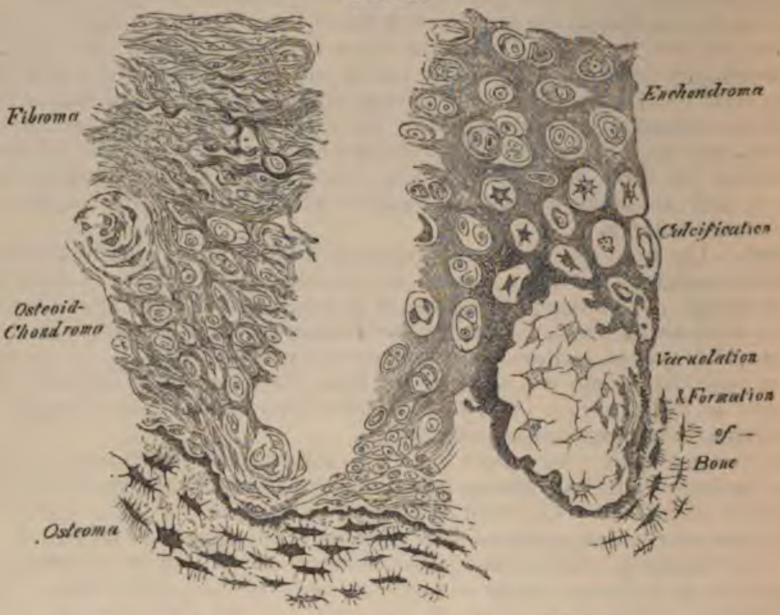
Recurrent or semi-malignant.—Auto-infection is, in some kinds of tumors, incomplete in its manifestation. Thus, some spindle-cell sarcomas will recur often after removal, and yet show little tendency to invade the internal parts. Then, again, squamo-epithelial cancer extends to the glands, but not generally to the viscera. Also, soft, quickly growing sarcomata will extend fiercely to the viscera, and not invade the glands at all. In other words, auto-infection, in its three branches, viz., infection of site, of gland, and of viscera, is not seen equally in all the sorts of infectious tumors. This is significant, and needs working out. It is convenient to call imperfectly malignant tumors semi-malignant. Sir J. Paget proposed the term recurrent fibroid for spindle-cell sarcoma, and its use was at one time general, but is now giving way to the more systematic term. Some classification of the partially infectious tumors by their kinds of infectiousness may be agreed upon, but as yet the time has not come for it.

OSTEOMA, OSTEOID CHONDROMA, ENCHONDROMA.

When bone forms a large part or apparently the whole of a tumor, the tumor is called an osteoma; but no tumor is ever formed altogether of bone, there is always present an ossifying matrix by the ossification of which the bony part of the growth enlarges. The kind of matrix varies much; thus, sarcomata or even carcinomata may directly ossify, and so we get ***osteo-sarcoma*** and ***osteo-carcinoma***; but the kinds of matrix which produce growths of practically a bony nature are generally two, viz., periosteum and cartilage. Periosteum, or to speak more exactly a tissue resembling closely the deeper layer of the periosteum, forms large tumors whose transformation into bone takes place in the manner shown in the left side of Fig. 28; the cells take the shape of bone-cells, and the matrix calcifies; these tumors are called ***osteoid chondroma*** or ***periosteoma***.

Cartilage often appears to be ossified when it is only petrified by deposit of calcareous salts in its matrix (see right side of Fig. 28); this change is, as is well known, the first step in ossification of cartilage. In many cartilage-tumors the process goes no further, or it may proceed to complete ossification through the several stages shown in the right side of the figure, viz., vacuolation, formation of medulla-cells in the vacuoles, and direct transformation of these to bone cells, as seen in the lower and right part of the drawing. More rarely the cartilage-cells, without calcifying, proliferate and change directly into bone, as seen in the middle of the figure.

FIG. 28.



Microscopical anatomy of osteoma, osteoid chondroma and enchondroma.

The amount of cartilage, periosteum, or bone, present varies indefinitely in different cases. When cartilage preponderates the tumor is called an *enchondroma;* when bone preponderates, an *exostosis, osteoma,* etc., according to its shape and connections; when periosteum preponderates, an *osteoid chondroma,* as before said.

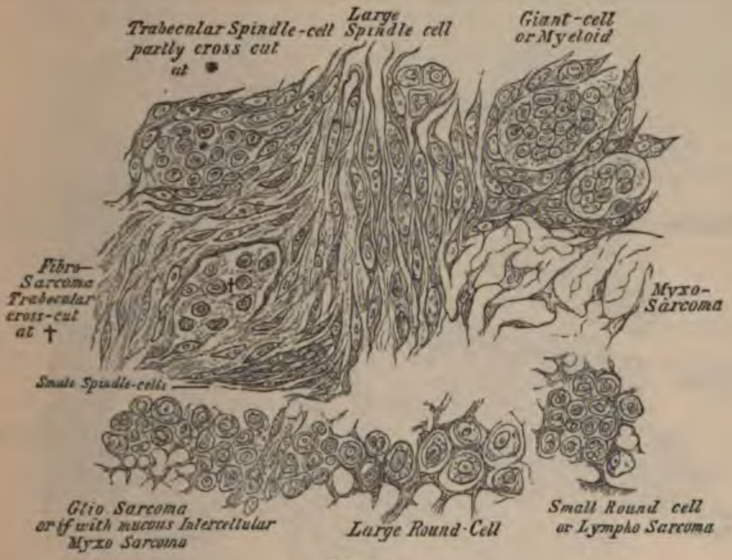
Occasionally the amount of bone and cartilage is so equal that it is a matter of difficulty to decide which name shall be used; and then the terms *cartilaginous exostosis* or *ossifying enchondroma* are employed. *Osteoid chondromata* are to be suspected of malignancy; such tumors compose a part of what were called *osteoid cancers.*

SARCOMA.

The schematic figure (29) is composed of accurate drawings of portions of the several kinds of sarcoma named, but they are gathered together in a diagrammatic way, the forms being graduated into each other as they are when found side by side in the same tumor. You meet, indeed, with all gradations of intermediate forms; for although, as a general rule, one kind of sarcomatous tissue prevails in a tumor, it is far from unfrequent to have more than one of the kinds present together, the characters of each changing into those of the other.

The distinctive histological character of *sarcoma* is the possession of a stroma between the cells, an atmosphere of intermediate matter which surrounds each and is between them all; the qualities of this intermediate or "intercellular" matter determine the kind of sarcoma, as in the class of connective tissues whose developmental stages the several kinds of sarcoma closely resemble. The class of connective tissues includes the several kinds of texture whose office in the body is passively mechanical, either in serving as adjuncts to the muscular system or by filling up interstices between organs of the body or by entering into textures to support their component parts, bloodvessels, etc. Those connective tissues which penetrate into any of the organs of the body are modified in consistence and in arrangement of their elements according to the requirements of the organ. Thus, in the brain the connective tissue, called Neuroglia, is very delicate and soft, and has scarcely any distinctness. Also the connective tissue which enters into the lymphatic glands becomes reduced to very soft fibrillar matter between the lymph-cells. In these instances, and in others, the connective tissue thus comes to have pecularities and to constitute strongly marked varieties. Yet all connective tissues possess this common feature in their elementary structural composition—that they are made up of cellular bodies between which their proper substance forms an intercellular matter.

Fig. 29.


Trabecular Spindle-cell partly cross cut at *
Large Spindle cell
Giant-cell or Myeloid
Fibro-Sarcoma Trabecular cross-cut at †
Myxo-Sarcoma
Small Spindle-cells
Glio Sarcoma or if with mucous Intercellular Myxo Sarcoma
Large Round-Cell
Small Round cell or Lympho Sarcoma

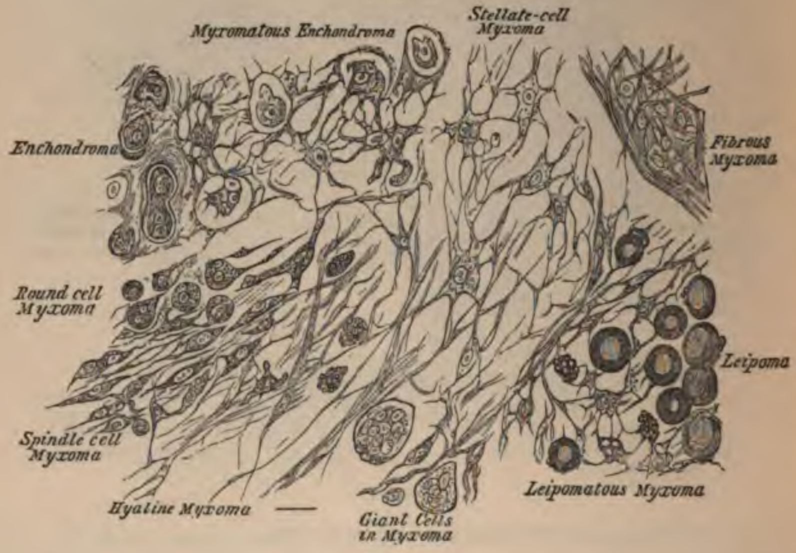
Sarcoma.

The relation of sarcoma to the connective class of tissues appears to be this, that when one of these tissues is produced very rapidly it has no time for its intercellular matter to acquire the proper characters, and so remains indeterminate, while it also is small in quantity, the cells greatly preponderating. Thus, any of the normal connective tissues may produce by rapid development a tumor of sarcous tissues or sarcoma (the name is well chosen, σαρξ, which equals *caro* or our word *flesh*, means commonly any soft animal substance, not blood nor bone). Thus it follows that there are several kinds of sarcoma, according to the tissues from which they are developed. The principal of these are seen in the above schematic figure. The round-celled kinds generally arise from lymph-gland, or neuroglia, or mucous tissue; hence they are common in myxo- or glio- or lympho-sarcoma. The spindle-celled kinds arise from connective, fibrous, or bony tissue, and hence are most common in fibro-sarcoma or osteo-sarcoma.

MYXOMA.

The name myxoma is given to all tumors of connective-tissue type (not epithelial) which contain mucus or mucin in their intercellular matter. It corresponds nearly to gelatinous sarcoma, collonema, and fibro-cellular tumor of old authors; the forms of the cells are very variable, but in the most typical examples, and especially in the older and fully developed parts, the cells are large and usually multipolar or "stellate," with a distinct nucleus and nucleolus; the stellate branching rays of the cells are mutually connected, so as to form a more or less open network, in the interstices of which the mucous semi-fluid lodges. Beams and bands, which generally have a stiff rigid appearance and an angular rather than a wavy disposition, pass about, dividing up the substance of the tumor into very imperfectly defined sections, more or less visible to the naked eye; from these arise fine fibrils continuous with the cellulo-fibrillar network. Much of the tumor, and especially the younger part, may be found formed of spindle-cells; these are really connected, by threads from their sides, with the intermediate fibrillar network, and it can often be seen that the stellate forms are produced by the drawing out of these threads to greater lengths, through the separation of the texture elements by the increasing quantity of mucus. In yet other examples or parts the prevailing form of the cells is round, or with one pole; the round cells resemble ordinary mucous corpuscles, and are scattered among the fibrils in the mucoid matter; they often contain many fat-grains, and are found in the oldest parts of the tumor, representing the senescence of its cells. There is also a great variability of the intercellular substance, first, in proportion of the fibrous to the cellular part; and second, in the proportion which these solid elements bear to the mucoid interstitial matter; thus, there is a fibrous myxoma, and a clear pellucid variety, with much mucous fluid, perhaps even forming cysts (hyaline and cystic myxoma). In some examples there are large polynucleated cells, identical with the so-called giant-cells of "giant-cell" sarcoma.

Fig. 30.



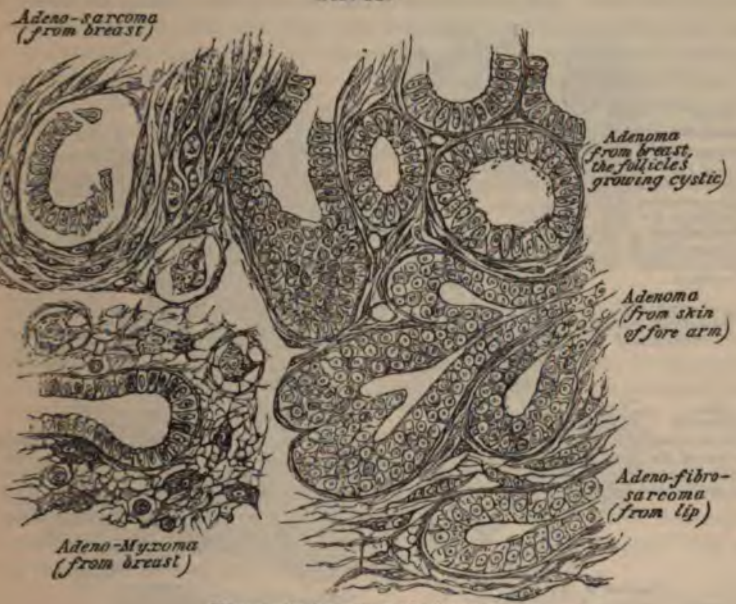
Myxoma.

In the theory of types, myxoma is affiliated to certain natural tissues, in particular the jelly of the umbilical cord, the vitreous of the eye at a stage of its development, and the early stages of adipose tissue, or to a stage of bone formation out of cartilage. It will be seen that these typical tissues are only transitory in their nature, as compared with such stable tissues as bone, cartilage, tendon. In accordance with this instability of their type, myxomas themselves show many transitions to various kinds of connective tissue; these transitions are chiefly towards cartilage or fat (myxomatous enchondroma, myxomatous lipoma). Tumors are not infrequent, especially in the parotid region, which are intermediate between cartilage and mucous tissue, so that one cannot say to which they most properly belong; also, many fatty tumors show clear gelatinous patches of mucous tissue in all transitions to fat, while many myxomata show opaque spots composed of true adipose tissue.

ADENOMA.

The essential character of adenoma lies in the possession of a glandular structure; but the comparative amount of the glandular element varies much. There is also variety in the kind of tissue which is found between the gland-follicles. Some tumors show structure almost identical with that of compound racemose glands, having natural-looking follicles separated by delicate connective tissue; more commonly the follicles are dilated more or less, so as to form cysts; one or more of these may prevail, so as to give a cystic character to the whole (cystic adenoma). Besides the cysts arising in this way, others may be formed by a breaking down of the intermediate tissue, especially if it happen to be mucous tissue. But as a rule the glandular elements are surrounded and separated by a more plentiful formation, which may be so much developed as to more or less entirely take away the glandular character of the growth; this interstitial tissue may either be fibrinous, sarcous, or mucous, or more rarely cartilaginous or areolar; or it may present characters combining these or mediate between them (*adeno-fibroma — sarcoma — myxoma*). When the proportion of gland is small, there is doubt whether it is not part of the original gland-tissue persisting in the new substance. Thus, the relative augmentation of the cavities of ducts or follicles may make the tumor take the character of cyst, or the relative augmentation of the intermediate tissue may make it take the character of sarcoma, myxoma, or fibroma; but if the glandular substance is maintained in due proportion, the natural resemblance of adenoma is to carcinoma.

FIG. 31.


Adeno-sarcoma (from breast)
Adenoma (from breast, the follicles growing cystic)
Adenoma (from skin of fore arm)
Adeno-fibro-sarcoma (from lip)
Adeno-Myxoma (from breast)

Microscopical anatomy of adenoma.

And, indeed, if the glandular substance is maintained in due proportion, then a very little change is needed to give to adenoma the characters of carcinoma. When the characters of carcinoma are studied it will be found that these characters are of the same general description as those of adenoma. In either case there is a meshwork of fibrous or sarcous substance, forming spaces in which cells of a more or less epithelioid type are packed together. The difference is one sometimes requiring close observation and not always to be determined quite satisfactorily, whilst in other cases it is obvious enough. The structural difference between adenoma and carcinoma lies in this, that in an adenomatous tumor the glandular epithelium is regular and composed of even-sized and relatively small cells, whose nuclei are generally single and do not contain many nucleoli; the cells do not vary in form, and line the follicles of the adenoid texture in an even and orderly manner; whilst in carcinoma the nuclei in the cells are larger and brighter, and have many nuclei, and the cells vary much in form and size and compose usually compact masses projecting into irregular bulbs in the sarcous stroma, instead of lining follicular cavities.

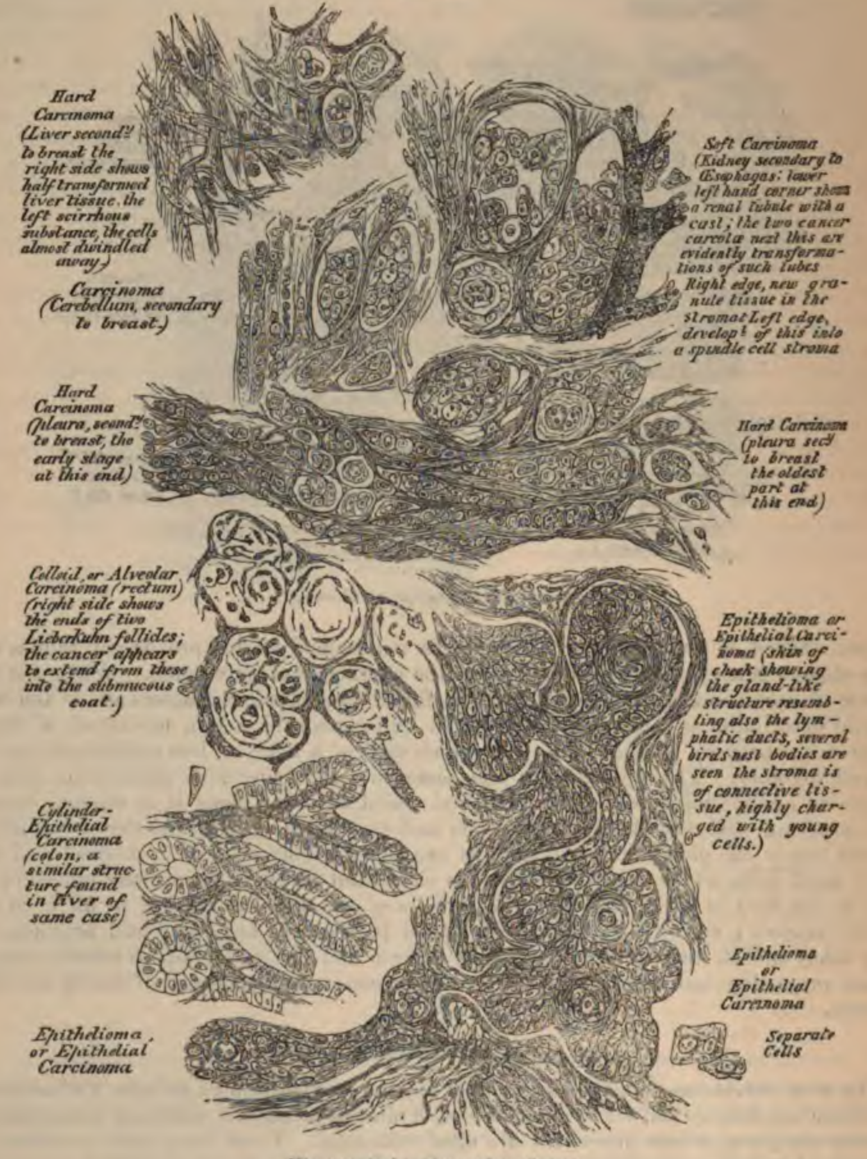
CARCINOMA.

The term carcinoma is now distinctively applied to such tumors as have a structure of the following description, viz.—A meshwork of fibrous or sarcous substance composing an alveolar structure, whose interstices are filled with cells. These may have no orderly or methodical-looking arrangement, being packed in the crevices in the meshwork (or alveoli, as they are called), and extending casually from alveolus to alveolus, so as to make a complementary meshwork. The carcinomatous character is determined by the presence of such alveolar structure, with cell-collections lodged in it; the decisive point consists in these cells lying close together without any intercellular substance; the cells generally vary in shape, and have large nuclei, with large and bright nucleoli. But often the cells have an arrangement very like the epithelial lining of the follicles of the secreting glands, a structure which may be so well pronounced as to bring them almost into continuity with adenomas; they differ from these chiefly in their history as being infectious, so as to extend into the neighboring tissues, to the glands, or to the viscera. The structure showing only those minor peculiarities which I have just described.

Five leading types of carcinoma may at present be conveniently distinguished.

1st. Those in which the fibrous meshwork is in preponderance, and the epithelioid contents of the alveoli are scanty, and, perhaps, also prone to perish early, so that they are found more or less degenerate within the fibrous meshes—Hard Carcinoma, or Scirrhus.

FIG. 32.


Hard Carcinoma (Liver second^y to breast the right side shows half transformed liver tissue, the left scirrhous substance, the cells almost dwindled away.)
Carcinoma (Cerebellum, secondary to breast.)
Hard Carcinoma (pleura, second^y to breast, the early stage at this end)
Colloid, or Alveolar Carcinoma (rectum) (right side shows the ends of two Lieberkühn follicles; the cancer appears to extend from these into the submucous coat.)
Cylinder-Epithelial Carcinoma (colon, a similar structure found in liver of same case)
Epithelioma, or Epithelial Carcinoma
Soft Carcinoma (Kidney secondary to Œsophagus: lower left hand corner shows a renal tubule with a cast; the two cancer caveolæ next this are evidently transformations of such tubes Right edge, new granule tissue in the stroma Left edge, develop^t of this into a spindle cell stroma
Hard Carcinoma (pleura sec^y to breast the oldest part at this end)
Epithelioma or Epithelial Carcinoma (skin of cheek showing the gland-like structure resembling also the lymphatic ducts, several birds nest bodies are seen the stroma is of connective tissue, highly charged with young cells.)
Epithelioma or Epithelial Carcinoma
Separate Cells

Microscopical anatomy of carcinoma

2d. Those in which the fibrous meshwork is in smaller proportion, and the epithelioid contents are plentiful, making large collections of cells, but with no evident approach in the form of these collections to the shapes of gland-acini, and no evident resemblance of the component cells, either to the columnar epithelium of mucous glands, or the squamous epithelium of cuticle—Soft Carcinoma. This kind occurs especially in glands, and the transformation of the glandular tubes or follicles to cancer alveoli can be seen in all stages in the growing margin of the tumor (see the upper two drawings in Fig. 32, from the liver and kidney).

3d. A structure essentially such as that last described, but with this difference, that the epithelioid cells have a quantity of mucus between them, which is regarded as arising from a transformation of them. This change to mucus may be carried to such an extreme that scarcely any cellular elements are left, while the alveolar meshes in which the mucus is contained becomes very strikingly visible from its nakedness and the pellucidity of the mucus—Colloid or Alveolar Cancer. A common seat of this is the wall of the alimentary canal, where it may be traced arising from Lieberkühn's follicles.

4th. A structure in which the epithelial cells resemble squamous epithelium, and form masses which are very like the follicles of cutaneous glands, or occasionally like rudimentary hairs; the tubular and bulbous forms may, however, be seen ramifying like the lymphatic vessels of the skin, as if their form were moulded to the lymphatic plexus—Epithelioma. In these cancers peculiar bodies are found, composed of flattened cells disposed concentrically so as to form a scaly-walled globe (Fig. 32) whose appearance is like the section of an onion, or like a bird's nest; these are so large as often to be visible to the naked eye; when they are numerous and well characterized, they are diagnostic; some authors (Billroth) distinguish a variety of this cancer in which the stroma preponderates over the epithelial part, calling it scirrhus of the skin—Squamous Epithelial Carcinoma.

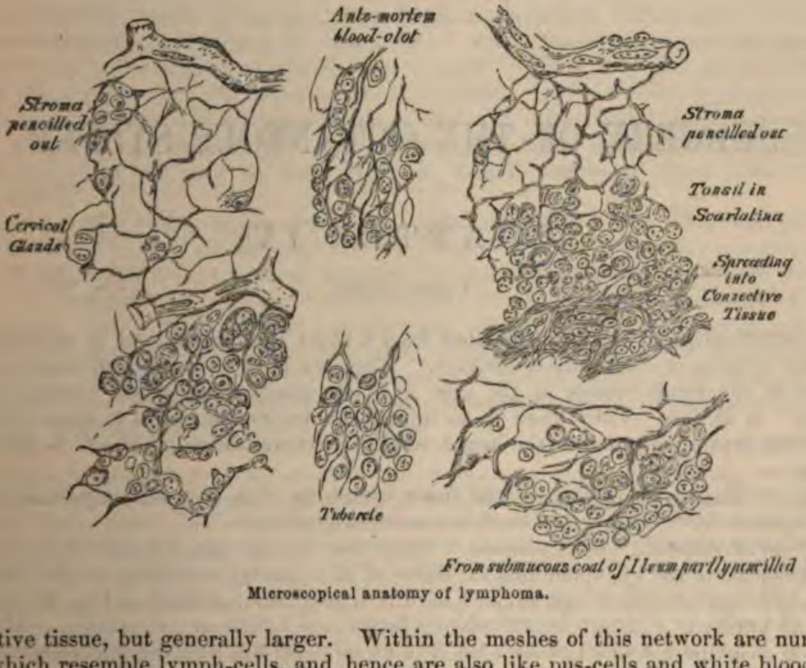
5th. A structure in which the epithelial cells resemble ordinary columnar epithelium, and the structure itself is quite like normal mucous membrane, in which it always primarily arises (alimentary canal, especially colon, uterus); the secondary formations which occasionally occur in these cases, in the liver especially, have the same structure, and thus a tissue like the glandular mucous membrane of the colon may be found in the liver—Cylindrical Epithelial Carcinoma.

The fourth and fifth varieties are distinguished from the three first as epithelial cancers or epitheliomata. Some authors have used the term cancroid for the fourth variety, as though it were not completely cancerous. These are less likely to infect the viscera than the first two varieties, which are the most infectious of all tumors, though they are very far from being the only kinds of infectious tumors.

LYMPHOMA.

The name lymphoma is given to such growths as have a microscopic structure like that of lymphatic glands; in particular, which have a finely reticular meshwork, connected with which are some fixed cells at tolerably regular intervals, not unlike the fixed cells of connective tissue, but generally larger. Within the meshes of this network are numerous cells, which resemble lymph-cells, and hence are also like pus-cells and white blood-cells.

FIG. 33.



Microscopical anatomy of lymphoma.

The proportion of network to the contained lymphoid cells is variable; sometimes the quantity of fibre is great, and the structure is then like lymph-gland tissue hardened by chronic inflammation. In other cases the proportion of cells becomes very large, while the network grows very delicate and open textured. The fixed stellate cells here appear to multiply, and produce a progeny of the loose movable cells in the meshwork, as if infected by the latter. The whole mass then appears as fine filaments making bold meshes, which are filled with round granular cells, like lymph-cells, but generally larger than these, and having large nucleus and many bright nucleoli. Such cells at first appear to make up the whole substance, but they easily brush or wash out of the meshes, leaving the network very conspicuous. It will be noticed that the degree of structure here described is very rudimentary. Indeed, sections of *ante-mortem* blood-clot from within a vein (see figure) closely correspond to the description. So also does tubercle in the more recently formed outer edge of it, where its texture is very like blood-clot; hence it is by some classed with lymphoma. Scarlatinous tonsils and typhoid Peyer's patches likewise have lymphoma structure. However, the plan of structure is so meagre that it is not enough to form a bond of union between diseases clinically so remote.

When found in the form of tumors, more properly so called, lymphoma generally takes its rise in the lymphatic glands; those of the neck are especially liable to it, then those of the abdomen and of the mediastinum. It is also found in the alimentary canal, especially the small intestine and stomach, and in the spleen, liver, kidney, &c. Formations of a similar structure have been met with in various organs in leukæmia, chiefly in the liver, in the form of small grains of a pale substance.

Lymphoma may prove malignant, that is, infectious to parts around, especially when the cellular elements are very numerous (in which case the tumor is called lymphosarcoma by Virchow); it then corresponds to a part of what used to be included under the whole name medullary cancer, which, as formerly used, would include also soft sarcoma and soft carcinoma. Indeed, these tumors, when the cell-elements greatly preponderate, become very much like each other, if not undistinguishable as far as their mere structure is concerned.

Virchow, 'Die Krankhaften Geschwülste,' 1862–5.—*Paget*, 'Surgical Pathology,' 1870.—*Abernethy*, 'On Tumors.'—'Pathological Society Trans.'—*Wilks and Moxon*, 'Pathology.'—*Billroth*, 'Elémens de Pathologie Chirurgicale,' 1868.—*Holmes*, 'System of Surgery,' 1870—'Debate on Cancer of Pathological Society,' 1874.

SURGERY OF THE CUTANEOUS SYSTEM.

CHAPTER IV.

CONTUSIONS.

A "**contusion**" is caused by a blow from a blunt instrument, and is uncomplicated with any solution of continuity of the skin. When the blow has been sufficient to produce rupture of the small vessels in the skin and subcutaneous tissue, an "*ecchymosis*" or "*bruise*" is said to exist; when it so injures the deeper tissues as to cause effusion of blood from rupture of some of the larger vessels, "*extravasation of blood*" is said to be present.

Pain, swelling, and bruising are the three symptoms that consecutively follow a blow. In mild cases, however, the last need not necessarily follow.

An "**ecchymosis**" is an effusion of blood *into* the skin and subcutaneous tissue, and it shows itself within a few minutes or hours of the injury, according to the force employed and depth of tissue injured, as a livid red, deep blue, or black patch, which in the course of twelve or eighteen hours becomes larger and lighter at its margins. About the third day it assumes a violet tint, on the fifth an olive brown, on the sixth a green, on the seventh or eighth it has a yellow aspect, and this fading into a lemon tint then disappears altogether. An ordinary bruise generally runs through all these stages in about two weeks, the rapidity of the process depending much upon the amount of blood effused and the reparative power of the patient. When no blood has been effused into the skin, but "extravasation" taken place in the deeper parts beneath a dense fascia, the discoloration of the integuments may not appear for three or four days, while in some cases where the blood has made its way between the tissues, and reached the skin away from the seat of injury, the "ecchymosis" will be at some distance from the spot at which the injury was received; and when much effused blood exists, the swelling will be great.

On making a section of a bruised part, the skin will be found throughout its thickness infiltrated with blood, and will feel firmer and thicker than natural. These points are sufficient to indicate the fact that the bruise had been received during life; for a blow applied to a body after death will never cause such general effusion of blood into the cutis, nor such an increase of firmness in the skin, while the effusion of blood that takes place will be in small quantities and venous, and beneath or upon, not in, the cutis.

Neither *purpuric patches* nor those of "*erythema nodosum*" ought to be mistaken for bruises. The general diffusion of the spots over the body in the one case, and the history and general aspect of the other affection, should prevent the error. It should be remembered, however, that in purpuric patients and in "bleeders" a slight blow or pinch may be followed by a severe bruise.

A slight contusion may only be followed by some local pain and swelling, the swelling becoming red, and then disappearing. The wheal that rises after a lash with a whip is the best illustration of this fact.

A severe contusion may cause a rupture of a large artery or vein, under which circumstances a fatal extravasation may ensue; or, it may so crush or pulp the tissues as to destroy their vitality; which a spent cannon-ball may accomplish. More frequently, however, a severe contusion causes a separation of the skin from the deep fascia and parts beneath, with more or less extravasation of blood into the split tissues. The effects of a contusion also vary according to locality; thus, in an adult a blow over the scalp may be followed by a local effusion of blood, and in a child this effusion may go on so as to form a swelling involving more or less of the whole vertex. In the buttocks and loins blood may be so effused as to give rise to a large fluctuating tumor. In the loose cellular tissue of the scrotum an effusion of blood may give rise to enormous enlargement, and in the eye every one is familiar with the change. Where the extravasation of blood has been extensive, the removal of the clot is a work of time. In some cases the blood remains fluid for a long period, and at length becomes absorbed; in some it breaks down, and gives rise to suppuration. In exceptional instances it becomes apparently encysted, and "there is sufficient reason to believe," says Paget, "that blood extravasated in a contusion may be organized, requiring the character of connective tissue, becoming vascular, and taking part in the repair of the injured tissues." These changes are seen in the repair of fractures, and in ligatured or twisted vessels. In some cases, in which a large blood tumor formed, and a solid coagulum existed, the clot suddenly softens down, and is then absorbed. In March, 1876, this was well illustrated in the case of a boy, æt. 12, who was under my care in Guy's Hospital, with an enormous blood tumor in the gluteal region.

TREATMENT.—A slight bruise requires no treatment, and if left alone will get well, for blood is often rapidly absorbed, as is seen in the eye. *To check extravasation*, cold is the best application in the form of pounded ice in a bag, or a mixture of salt and saltpetre, or the iced poultice.[1] Should any disposition to inflame appear, some lead or spirit lotion may be used. To hasten on the absorption of the effused blood, tonics are often of service, and the application of gentle pressure by means of bandages or strappings.

A lotion of the tincture of arnica, one ounce to a pint of water, seems to have some influence in hastening the absorption of blood. Some of the stimulating liniments, such as the soap or opium, may likewise be employed.

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[1] *Ice poultices*, as suggested by Maissoneuve, are excellent for the local application of cold, and are made as follows: Take of linseed meal a sufficient quantity to form a layer from three-quarters to an inch thick, spread a cloth of proper size; upon this at intervals of an inch or more, place lumps of ice of a convenient size—of a big marble—then sprinkle them over lightly with the meal, cover with another cloth, folding in the edges to prevent the escape of the mass, and apply the thick side to the surface of wound. The exclusion of air retards the melting of the ice and the thick layer intervening between it and the surface prevents painful or injurious contact. In injuries to the abdomen this remedy is very applicable. Dr. W. H. Doughty, of the U. S. A., speaks highly of it. Circular No. 3.

In more severe and extensive effusion of blood, when the circulation in the part is interfered with, cotton wool or lint soaked in oil and covered with cotton wool are the best dressings; by them warmth is maintained in the part; moist applications are not so good.

When the blood remains fluid, the surgeon must not be tempted to draw it off until all hope of its absorption has been abandoned. To meddle in these cases is often injurious; but when the blood has broken up and suppuration appeared, a free incision into the part, followed by the application of a poultice, is good practice, the cavity being kept clean by syringing with Condy's fluid of iodine lotion.

When the fluid blood has to be evacuated, it ought to be effected by a free opening, unless it can be drawn off by the "aspirator," or exhausting syringe, as by this means the fluid is removed and no air let in.

Wounds.

When the soft parts of the body are divided by any mechanical force applied externally, they are said to be wounded; when the "solution of continuity" is produced by a sharp-edged instrument, the wound is called "*incised;*" when with a pointed one that stabs or pricks, "*punctured;*" when with a blunt instrument that tears, "*lacerated;*" and when with any implement that bruises, "*contused.*"

When the parts are only divided, the wound is called "*simple;*" when associated with the introduction of foreign bodies, accompanied by hemorrhage or pain, "*complicated.*"

All the above wounds are described as being "*open.*" (The outer part of the wound so gaping as to expose the deeper parts.) This term being applied in contradistinction to the "*subcutaneous,*" or that in which the external wound is very small in comparison with the internal.

Incised wounds, as made by accident or operation, *gape* much when the divided tissues are on the stretch, or the wound is transverse. In some localities this gaping is more marked than in others, the elasticity of the skin and possibly its muscularity influencing this result. Thus, in the sole of the foot and palm of the hand, the separation of the edges of a wound is very slight, when in the full mammary gland or in other parts of the body in which there is abundance of fatty tissue beneath the skin, the gaping is very great.

The skin is the most elastic tissue in the body, and retracts on division more than any other. Arteries, probably, are next, and muscles stand third, these facts being well exemplified in a flap amputation.

The "*bleeding*" that attends an incised wound depends entirely upon the size, number, and character of the vessels divided. In most people the division of *capillaries* stops by natural processes, except in subjects of the hemorrhagic diathesis. *Venous* bleeding also, except from large trunks, usually soon ceases on elevating the part or on the application of a little steady pressure. *Arterial* hemorrhage will be profuse when from large vessels, or persistent till the bleeding vessel has been secured by torsion or ligature.

The *pain* attending an incised wound varies in its nature and degree, according to the sensibility of the patient and position of the wound, the pain of anticipation doubtless aggravating it in the case of an operation.

TREATMENT.—*To arrest bleeding* is the surgeon's first aim, and in the chapter on hemorrhage the necessary means will be discussed. To *clean the wound* by the removal of all foreign material is the next, which is to be done by the fingers and forceps of the surgeon, and a stream of water over the part, aided by cotton wool, clean sponge, or tow. The less manipulation the surface of the wound is subjected to the better.

Where primary union is wanted, the cut surfaces and *edges of the wounds are to be brought into apposition* by means of sutures and probably by strapping, and when the wound is a deep one these objects are materially assisted by the lateral application of pads and the pressure of a bandage. Indeed, in the treatment of all large wounds, whether the result of accident or operation, in which primary union is desired, the benefit of a little firm pressure over the part is very advantageous; in some cases a pad of lint is the best material to use, in others cotton wool, while the whole should be bound together by some good strapping or a bandage. Where the edges of a wound can be brought together without sutures or strapping, a pad of dry lint fixed over the part by a bandage is an efficient dressing. Small and superficial wounds may be brought together by strapping, sutures being only employed when the length of wound is very extensive, or where there is too much gaping, or, as on the face, where the strapping cannot be accurately applied.

In superficial wounds the flexible collodion of the British Pharmacopœia may be used, the edges of the wound being held in apposition whilst it sets. Two or three coatings must be applied.

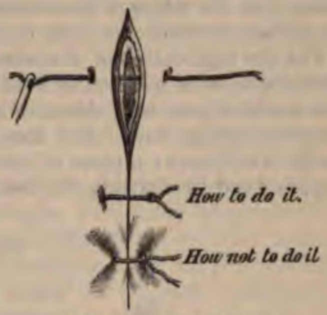
In wounds where sutures are not required, and the edges can be brought together, lint saturated with the compound tincture of benzoin is the best application.

Sutures in superficial wounds may be inserted superficially, but in deep wounds must be put in deeply. To adapt the skin surfaces of a deep wound without procuring apposition in the deeper parts is bad practice, and, where union takes place, it produces harm, by holding in the secretions. Sutures should only in exceptional cases pass through muscles.

Suture.—There are four principal kinds of sutures; the *interrupted*, *uninterrupted*, *twisted*, and *quilled*.

The **interrupted suture** is that usually employed in ordinary wounds. It can be made with a curved or straight needle, according to convenience, armed with a single thread of well-waxed silk—the fine silk line sold by tacklemakers being the best. The needle is then introduced through one side of the wound from without, inwards, obliquely through the tissues, and made to pass through the opposite side in the same direction from within, outwards. The edges of the wound should then be carefully drawn together, and the two ends of the suture fastened in a double-reef knot. A granny (Fig. 120) is by no means a bad knot to make, as it is a slip knot, and may be tightened at pleasure, a third knot securing the whole. The knot of the suture too should be brought to one side of the wound (Fig. 34); and in fastening the suture it is only necessary to draw the knot tight enough to keep the edges of the wound in apposition, and not to strangle them, as illustrated in Fig. 34. In a large wound, sutures and strapping may alternate; in others the sutures may be inserted about half or three-quarters of an inch apart.

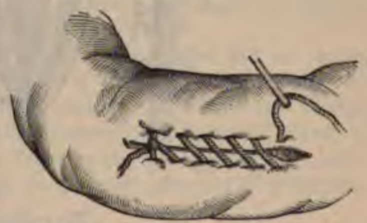
FIG. 34.



The interrupted suture.

The **uninterrupted,** continuous, or Glover's suture is usually employed where a very close and accurate adaptation of the margins of the wound is wanted, as in wounds of the intestines, the eyelid, the face, and the penis after circumcision in the adult; also after the removal of the breast or other tumor. For this purpose the needle should be small and the ligature fine; and the stitch is that of the seamstress. Fig. 35 illustrates the sutures as applied to the intestine.

FIG. 35.

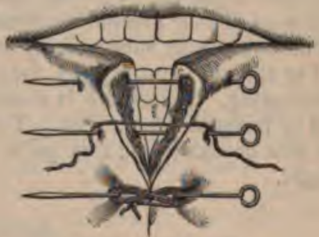


The continued suture as applied to the intestine.

In both these forms of suture the stitches should be removed on the third or fourth day; they may often be taken out from the face on the second. If left in long they set up irritation and ulceration.

Iron, or silver wire sutures are preferred by some, as they are thought to be less irritating than silk. I have tested them together in the same wound on many occasions, and have failed to confirm this assertion. They are not, however, more irritating, and may be used; nor need they be tied, a double twist being sufficient to secure their ends. Wire sutures at times, however, set up very little irritation. Gut and horsehair seem to be the least irritating materials we possess for sutures, and should be used in plastic operations.

FIG. 36.



The twisted suture.

The **twisted suture** is that which formerly was always employed for bringing together the parts after the operation for harelip. It is still often so used, as well as in cheilo-plastic operations and others on the face and abdominal walls. To apply it, some fine pins with flat heads, silk, and cutting pliers are wanted.

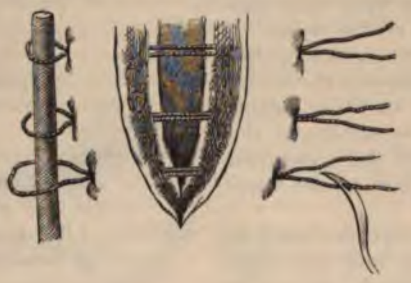
The pins are employed to bring the *surfaces* of the wound in contact. In lip cases, the point should be introduced half an inch or more from the margin of the wound, and passed obliquely through its thickness down to, but not through, the lining mucous membrane (Fig. 36), then it should be introduced into the opposite side and brought out through the skin at a corresponding point. With a piece of silk the wound may then be drawn together by means of a figure-of-eight twist around the two ends. Should the apposition of the surfaces be imperfect, the pin should be taken out and readjusted, and in this lies the great advantage of this form of suture. A second and third pin may then be introduced in the same way. After the silk has been tied in knots and the ends cut off, the points of the needles ought to be removed, and the soft parts protected, if necessary, from the ends by a small piece of lint or strapping passed beneath.

Instead of silk being twisted round the pins, a section of an india-rubber tube, in the form of a ring, has been employed by Mr. Gariel much in the same way as Mr. H. Lee applies his india rubber over a pin employed for varicose veins, either of the extremities or testicle. I have tried the plan in many cases, and find it, though beneficial, yet not better than silk.

The quilled suture is very valuable, particularly in deep wounds, tending more than any other to keep the parts in apposition. In plastic operations in the perineum in the female it has always been a favorite, and although I gave it up in these cases for many years in favor of metal sutures, I now use it with considerable success. In gastrostomy it is probably the best we possess for holding equably the margins of the open stomach to the edges of the wound, as it is in other cases of abdominal cysts, ovarian and otherwise, in which the same end is sought.

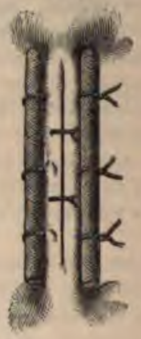
For the application of this suture, a strong curved needle with an eye at the end and threaded is to be inserted at least three quarters of an inch from one margin of the wound, and made to pass well down to its depths, then brought out through the other margin in a corresponding line. The loop of the suture should now be caught and held, and the needle withdrawn; a piece of bougie, cut the required length, being introduced into the loop, is fixed by drawing the free ends of the ligature home (Fig. 37). A second or third suture can be applied in the same way. A second piece of bougie ought then to be tied on the opposite margin of the wound, the parts having been well cleansed previously, and carefully adjusted. The surfaces of the wound are only to be held closely in apposition, and must not be pressed too firmly, otherwise the bougies will set up ulceration. Superficial sutures may subsequently be introduced into the edges of the wound (Fig. 38).

Fig. 37.



The quilled suture.

Fig. 38.



For the quill suture good fishing gut is better than silk or wire, it being strong, and unirritating. Before use it should be soaked in water to make it limp; it can be readily tied or fastened with a shot. The loops of the quill suture should generally be divided on the fifth or sixth day, this point depending on the amount of irritation caused by the bougie.

After-treatment of Wounds.

When the edges of an incised wound have been brought together and well adjusted by sutures, they rarely require more protection than that afforded by a piece of dry or oiled lint. Wounds of the face may be left exposed. Dr. Krönlein, of Zürich, indeed, advocates the open treatment of *all* wounds.

In wounds of moderate dimensions, on the third or fourth day when union may be expected to have taken place, the dressings and sutures should be removed, and, when the repair is good, the parts may be left open.

Should there be any gaping of the wound or disposition to gape, the surgeon should apply strips of plaster across its edges as he removes the sutures, thereby giving support to the parts and guarding against their reopening.

When the union between the edges of the wound is poor, and the parts have to heal by granulation, water dressing should be applied.

In large or deep wounds, where pads and pressure have been primarily applied, it is better to leave the dressings untouched for five or six days, and then only to remove them when evidence exists of the presence of some retained or irritating secretions, since it is better at times even to allow sutures to cut out their way than to disturb a wound in which quick repair is wanted and anticipated. When doubt exists as to the retention of fluids, some of the dresssings should be taken away to allow of their escape, for pent-up secretions are most injurious.

Indeed, to sum up in three words the essentials in the after-treatment of wounds—*non-interference*, *rest*, and *cleanliness*—include everything, for—

By *non-interference* is meant, after the careful adjustment of a wound, and the close observance of the points that have been already alluded to in the primary treatment of wounds, the exclusion of all such curiosity as shows itself in too frequent dressing and examination, too early removal of sutures and the forgetfulness to support the edges of a wound on their withdrawal, in the application of dressings that may irritate directly or indirectly, and last, but not least, in all roughness in dressing.

By *rest* is meant the preservation of the injured part by means of bandages, and other surgical appliances, in the most favorable position for the natural evolution of the reparative process; and the observance of due care that no external influence is brought to bear upon the wound so as to interfere with or interrupt it.

By *cleanliness* is meant not only the absolute cleanliness of all instruments, dressing apparatus, and dressers' fingers, the removal of all putrefying or putrefiable materials from the surface of a wound or its neighborhood, but the forethought which provides against the collection in as well as for the thorough evacuation from a wound of all pent-up fluid (whether blood, serum, or inflammatory products), by means of drainage openings or drainage tubes; and the care which sees that the air which surrounds the wound is not the vehicle of such infectious elements as may start erysipelas or septicæmic disease. The surgeon ought to know that wounds are as sensitive to outside impressions as are puerperal women, and that, in the one case as in the other, as much precaution is necessary to ward off external pernicious influences.

This latter part of the above principle of practice, however, is carried out in many ways; by such surgeons as Langenbeck of Berlin, Krönlein of Zurich, and Humphry of Cambridge, by the free exposure of the wound to a bath of fresh air; by Professor Lister and his followers by the exclusion of air that has not been rendered free from all *germs* of pollution by the unremitting use of what is regarded by them as the great germicide, carbolic acid, the wound upon this theory being so dressed as to insure absence of putrefaction.

For my own part, I am no convert to either of these extreme practices or theories, and whilst claiming to be an antiseptic surgeon as much as others, believe that in non-interference, rest, free drainage, and cleanliness, the surgeon can get all he wants.

Punctured wounds.—When these are made with *sharp* and *clean* instruments, and do not involve any important or diseased structure, they generally do well. When small, they do as well as the incised; and when large, are not so prone to unite by primary union.

When made, however, with *blunt* pointed, *rough*, or *dirty* instruments wounds never heal kindly, for the parts are *bruised* and *torn*, as well as separated, by the perforating instrument, and close again as soon as the instrument is withdrawn, thus there is retention of blood, and at a later stage of broken-down tissues, and should these decompose or mechanically irritate by their presence, inflammation appears with its local and constitutional symptoms. Should important parts be thus injured or the tissues be unhealthy, these results will be worse, and very serious consequences may then be expected.

When tense fasciæ, such as is found in the palm of the hand, sole of the foot, and scalp; or, when deep muscles, bound down by fascia, as in the thigh, are punctured, and such results ensue, the consequences are severe.

It is probable that it is the *bruising and tearing of the tissues* that make these punctured wounds worse than the incised; bruised and torn tissues rarely healing by primary union.

TREATMENT.—All punctured wounds, great or small, are to be treated with more caution than the incised. The parts should be kept at complete rest and elevated, a pad being carefully adjusted over the wound and evenly adjusted pressure applied to the parts. When all proceeds favorably, and repair ensues, the dressings may be left for four or five days, and afterwards removed, the parts still being kept at rest for another week.

Should pain or swelling follow this primary dressing, the dressings should be at once removed, and warm-water applications or a poultice applied. When there is any evidence of retained fluid in the part, the external wound must be opened, the extent of reopening depending upon the amount of tension of the part. When suppuration has taken place, a free vent for the discharge must be maintained. Pain must be relieved by opium, and the general powers maintained by tonics and carefully regulated stimulants.

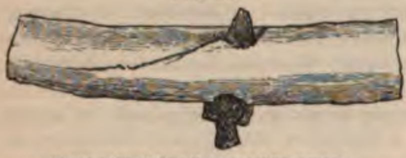
ARROW WOUNDS.

These have been made the subject of a special essay by Dr. Bill in the 'American Journal of Med. Science,' vol. xliv. He tells us that it is exceptional to meet with single wounds, the American Indians discharging their arrows so rapidly that if one takes effect it is immediately followed by others. The Washington Army Medical Museum contains specimens of penetrating arrow-wounds of the skull. Where both tables are punctured there is little or no fissuring externally or internally, as the vitreous table is penetrated as cleanly as the outer. "This is in such marked contrast to the results of bayonet or sword thrusts or of the impact of gunshot projectiles as to merit notice."

Arrow wounds of the chest are not always fatal; those of the abdomen are generally so. Dr. Bill tells us that the Indians on this account always aim at the umbilicus, and that the Mexicans when fighting the Indians on this account always envelop the abdomen.

The velocity of the arrow when first projected is so great that it has been estimated to equal nearly that of a musket ball. At a short distance an arrow will perforate the larger bones without comminuting them, or it will cause a slight fissure only, resembling in these respects the effect of a pistol ball fired through a pane of glass a few yards off. This is well seen in the drawing (Fig. 39), copied from a preparation of the section of the eleventh right rib of a buffalo fissured by an arrow, in the Washington Army Med. Mus., presented by Prof. Joseph Henry and copied from Circular No. 3.

FIG. 39.



Piece of buffalo rib pierced by arrow.
Surgeon-General's Office, U. S. Circ. 3.

The treatment of punctured vessels and cavities will be found in the chapters respectively devoted to those subjects.

Contused and lacerated wounds never heal by primary or immediate union. The injured parts are so bruised and separated that some portions of their surfaces are sure to die, hence healing by granulation is to be expected. They do not bleed as do the incised.

Nevertheless, they are to be treated with care, and as if they are sure to unite partially if not wholly. After their surfaces have been cleaned and freed from blood and dirt their edges may in many cases be brought together, sometimes by sutures, in others by strapping, care being always taken that the whole of the wound is not covered in, and that a free orifice is left for discharge. The surface of the wound may be covered with oiled or wet lint, and the parts should be well raised and kept at rest.

In skin lacerations of the extremities it is surprising at times to find how well the parts heal under this treatment, and how large portions of integument that have been torn off, when carefully readjusted, unite and maintain their vitality. When the parts are so injured that a fear of sloughing from want of arterial supply is felt, the whole should be wrapped up in cotton wool.

Water or oil dressing with or without opium, carbolic acid, or other drug, may be applied after the primary dressing has been removed, according to the requirements of the case.

Subcutaneous wounds are interesting subjects of study, inasmuch as surgeons are now familiar with the fact that tendons, muscles, and even bones may be freely divided with a very small cutaneous wound, and good repair follow, without any signs of inflammation, suppuration, or constitutional disturbance. When a tissue is divided, and its two divided surfaces are left in contact, they will unite as any other wound: yet when separated, the space between them will be filled in with new material that will organize and assume in time the characters of the divided tissue; at least, such changes occur in tendons.

These facts render the subject one of great interest, and should cause the surgeon to look out for opportunities of applying the practice to more extended classes of cases.

The treatment of subcutaneous wounds resolves itself into closing the wound with a pad leaving the parts alone, and allowing them to heal, the quiet way in which this takes place contrasting most favorably with the repair of open wounds. The non-admission of air (not of "germs") being, probably, an explanation of the difference.

The subject will be more fully considered in the chapter on The Surgery of Tendons.

BURNS AND SCALDS.

A burn is caused by the application of concentrated dry heat to the body; **a scald**, by the application of hot or boiling liquid. As a rule, scalds are less severe accidents than burns, because water being the ordinary fluid through which the scald is produced, is never hotter than 212° Fahrenheit; yet when any other chemical compound is the scalding medium, the effects are, at least, often as bad as the worst burns. The worst local burn I ever saw was when a man put his booted foot and ankle into a pot of molten lead. The limb came out covered with a boot of metal, and was destroyed even to the bones. Mr. Aston Key amputated the limb at once below the knee, without removing the metal.

A moderate degree of dry heat applied in the pursuit of a calling indurates the skin and blunts its sensibility; and an ironworker or a blacksmith can manipulate pieces of hot iron that would "burn" ordinary people. Thus, some skins or parts of the body are more sensitive than others, and, under the same influence, may be differently affected.

The effect of heat when applied to the body, varies according to its *intensity* and the duration of its application; it may cause a simple redness of the surface or the death of the part. Thus, its *first* morbid effect is mere *redness* and tenderness of the surface, and after a few hours, these symptoms may subside, the cuticle possibly desquamating.

In the *second degree* of heat inflammation is the result, this action manifesting its presence by the formation of a *blister*, from the effusion of serum beneath the cuticle.

In the *third degree* the superficial layer of the true skin is destroyed, the *surface appearing* of a *gray-yellowish or brown color*, not painful unless roughly handled. The vesicles that exist contain a blood-stained or brown fluid. The papillæ of the skin, with its nerves, are first destroyed; but, when in the course of a day or so, the dead surface has been "shed" and the nerves exposed, the pain is very severe, and the exposed surface has a reticulated surface.

In the *fourth degree*, the whole thickness of skin is destroyed, with more or less of the subcutaneous cellular tissue, the parts being converted into a hard, tough, dry, and insensible eschar, mottled with blood; vesication does not exist in this degree, all the superficial tissues having been destroyed. The skin surrounding the eschar may be blistered, but where it comes in contact with the injured part, it will be drawn into folds from the contraction, owing to the drying of the burnt integument; this puckering fairly indicates the important fact that the whole skin has been destroyed. The eschar does not begin to separate for four or five days, an inflammatory zone of redness with pain of some severity indicating the commencement of a process that will not be completed for two or three weeks. When the slough has come away, a long and tedious process of suppuration and granulation must be gone through prior to the repair of the exposed parts.

In the *fifth degree*, the skin with the deeper parts are involved—a black, brittle, charred mass taking the place of healthy tissues.

In the *sixth degree*, the whole thickness of a limb is carbonized.

These divisions, originally made by the great French surgeon Dupuytren, so well accord with all observation, that they have been invariably adopted by modern surgeons; and although, in burns and scalds, one degree passes imperceptibly into another, and in bad cases coexist, in the main, they can be made out.

Next to the *intensity* of the heat and *duration* of its application, the *extent of surface* involved is the most important point; indeed, as regards life, it is of far greater importance than the other two; because a superficial burn spread over a large surface—although not locally so injurious as a more severe one—is more fatal. In the majority of cases of death from burns and scalds, more particularly in children, the risk to life is fairly to be measured by the extent of surface involved; when more than half the body is injured, a fatal result generally ensues. A severe burn of a limited character may be, however, only a local affection.

Thus, the danger to life turns upon many points. In both young and old, all burns or scalds of any extent are serious. At any age extensive burns, however superficial, are to be feared, and they become serious from their immediate depressing effect upon the system; patients sometimes die from shock, and the very bad cases are marked by the sensation of *coldness* and persistent *shivering*. When the period of shock has passed, which varies from twelve to forty-eight hours, and that of reaction has set in, other dangers appear. Should the injury be over the thoracic cavity, chest complications may be looked for; and if over the abdomen, intestinal troubles. Burns and scalds of the head are not so likely to be followed by intracranial as those of the chest are by thoracic mischief. All intestinal complications should be carefully observed, as there seems to be a liability to irritation of the intestinal mucous tract, which may terminate at times in ulceration. Dupuytren first observed this in a general way, but Long ('Lond. Med. Gaz.,' 1840) and Curling ('Med.-Chir. Trans.,' vol. xxv) showed, that ulceration of the duodenum, as proved by inspection after death, and indicated during life by vomiting and purging of blood, is by no means an unfrequent result. Pathologists, however, are not unanimously agreed upon this point.

In the *second* or *inflammatory stage*, the injured parts are being thrown off, and most writers allow for this process about fourteen days, though in some cases it is less, and in others more. When, however, the slough has separated, and the parts begin to suppurate, the *third stage*, or *that of suppuration*, has commenced. In this stage, although there may be less probability of visceral complications appearing, there is the equally great danger of exhaustion, hectic, or pyæmia. Should these risks have been surmounted, there is yet the long and tedious process of the healing of the granulating surface, and at a still later period evils arise connected with the gradual contraction of the cicatricial tissue. This contraction only takes place when the *whole* skin has been destroyed. When the surface of the skin merely has been involved, and not its depth, the sore, on the removal of the slough, has a peculiar net-like appearance with a whitish or yellow ground, through the meshes of which granulations project.

When a person dies from a burn within forty-eight hours, it arises from shock or collapse, pain doubtless often adding to its influence; when a similar result takes place during the stage of reaction or the inflammatory stage, it is from visceral complication; and when during the third or suppurative stage, from exhaustion, visceral changes, or pyæmia.

When a person is said to have been "burnt to death," he dies from suffocation, the fumes of the fire destroying by asphyxia, and the fire subsequently burning the body.

Half the cases of burn admitted into a hospital die, and half of those that die, do so within the first three days.

The total deaths in England and Wales in a year from burns and scalds are about 2900, the females not being much in excess of the males.

Out of 408 cases consecutively admitted into Guy's, 275 were females, 143 males, the majority being children under five years old. Dr. Steele has also shown in his 'Septennial Report of Guy's, for 1868,' that out of 195 cases of burns from fire, 60 per cent. died; of 169 scalds, 16·5 per cent. died; of 18 burns from gas explosions, 11 per cent. proved fatal; and of 28 cases of burns from gunpowder, 14 per cent. succumbed, the difference between these classes of cases being very great, burns being four times as fatal as scalds, and these half as fatal again as gas explosions, &c.

Pathology.—Holmes has gone into this question more thoroughly than any other author ('System,' vol. ii), and has given us an analysis of 68 fatal cases examined after death. Nine died from shock in the first two days, all being children; 17 from exhaustion, 5 within the week, and 12 at later periods. In 3 cases in which the scalp was burnt, erysipelas proved fatal; in 3 pyæmia, and in 2 tetanus. In 11 cases of children cerebral complications caused death, and in most of these the symptoms appeared soon after the accident. In 6 cases inflammation of the larynx proved fatal, evidently from the direct inhalation of the flames; in 12 cases, where in all of which the burn was thoracic, chest complications killed; in 4 only did abdominal mischief prove fatal, and of these one had peritonitis, the result of a deep burn, two had hemorrhage from ulceration of the duodenum, and one had vomiting from the same cause.

Holmes and Erichsen also dwell upon the fact that cerebral and general visceral congestions are always present in fatal cases; indeed, in all, the congestion is a passive condition, due to the "sudden revulsion of blood from the surface," caused by the skin injury.

With respect to intestinal complication, it seems that out of Holmes's and Erichsen's 125 fatal cases, 16 presented ulceration in the duodenum, of which 5 died during the first week and 5 in the second, the situation of the burn in all but two being on the chest or abdomen. "The ulcer always has an indolent aspect, and is situated below the pylorus; often there are two or three close together; the edges of the ulcers are not raised nor everted; there is little or no evidence of inflammatory effusion in their neighborhood; when they are recently formed, they look simply as if a portion of the mucous membrane had been cut out; but when the ulcer has penetrated more deeply, so as to threaten perforation of the gut, lymph may often be found effused on its peritoneal surface. Sometimes the glands of the duodenum may be found enlarged." (Holmes.)

The symptoms of duodenal ulceration are most obscure, as neither pain nor tenderness exists; diarrhœa is neither constant nor excessive; vomiting is perhaps a more common symptom; and the presence of blood in the motions is highly suspicious. When the ulcer has perforated the intestine, intense pain, vomiting of blood, melæna, collapse, and abdominal distension mark the fact.

It should be noted that cicatrized duodenal ulcers have been found in patients who have died of other complications.

TREATMENT.—In all burns, great care should be observed in removing the clothes to save the cuticle. Blisters should be carefully punctured and their contents evacuated, the raised cuticle being gently pressed down to the true skin and covered by dressings. When the patient is cold, or shivering exists, he should be covered with a warm blanket and placed near the fire, some wine or brandy and hot water being administered. Professor Hebra speaks well of the warm bath under these circumstances. When the injury is extensive, one part should be uncovered and dressed before the other, as a free exposure of the surface tends to increase the shock and adds to the pain.

A pain is the constant accompaniment of all burns and scalds, and the exclusion of the air from the injured surface the best means of neutralizing it, the surgeon's object has ever been to find some method of treatment by which this result can be secured, and at Guy's Hospital the application of carron oil, consisting of equal parts of lime water and linseed oil, applied on lint and covered with cotton wool, has long been the favorite remedy, the whole being carefully kept in place by a bandage. At University College the burnt surface of whatever degree, is well covered with the finest wheaten flour by means of an ordinary dredger. At the London Hospital the application of zinc ointment on lint is employed. Dr. S. Gross, of America, uses white lead paint, and more recently, powdered clay has been employed. The dressings must not be changed for some days, not, indeed, until they have been loosened by the discharges or become offensive, inasmuch as the process of dressing any large burn is necessarily painful, and consequently injurious. To obviate the necessity of frequent changes of dressing, carbolic acid has been used dissolved in the oil, in the proportion of one part to ten or more.

Small burns or scalds may be treated by water dressing, lead lotion, collodion, Friar's balsam, goldbeater's skin, flour, chalk and water, &c. Two parts of collodion to one of castor oil is also an excellent application. In superficial burns this treatment is probably all that is required, the cuticle being re-formed in three or four days, and beyond some increase of redness in the parts the cure is nearly complete.

When the *first* dressing has been removed and the surgeon is able to make out the extent of tissue injured as well as the depth of the sloughs that are expected to separate, the character of the dressings may be altered, as it is best to hasten the sloughing process, which may be done by some stimulating dressing. Carbolic oil, made of one ounce of carbolic acid to a pint of olive or linseed oil, is very effective, or an ointment made of carbolic acid ʒiv, lard ℥iv, and castor oil ℥j; but these drugs will not avail when a very large surface is involved; and, under such circumstances they had better be applied to the sloughing parts, and the carron oil, or zinc, calamine, resin, or creasote ointment, ♏x of the last to an ounce of lard, to the other parts. A lotion composed of one drachm of the compound tincture of iodine to a pint of water is also beneficial. Sloughs, as they loosen, should be cut away, but never dragged. Deep sloughs are well treated by poultices, the turpentine ointment hastening their separation. When the surface is granulating it must be treated as any other open sore, and when the entire thickness of skin has been lost, as in burns of the fourth degree, the surgeon's closest attention is needed to counteract the contraction of the wound that will take place, thereby preventing the advent of those frightful deformities with which all are too familiar.

This can be done by extension, applied in some instances through mechanical appliances, in others, by means of bandaging and strapping. When the latter is used, the pressure should be exerted over the granulating surface as well as over the cicatricial border. The strapping must be good and made of linen, thin calico and leather yielding too much; and in the majority of cases nearly all requirements can be met by these means. The process of extension must be kept up during the whole period of granulation and cicatrization. Thus, in burns of the anterior surface of the neck the chin must be extended to the utmost from the sternum; in those of the thorax the arm must be kept from the side; and where the groin and parts around are involved, the thigh must be kept extended.

In addition to these means, we possess M. Reverdin's method of skin grafting; a practice consisting of the transplantation of small portions of true skin—these centres of cutification not only rapidly growing in healthy granulations, but having the power of imparting to the margins of the granulating tissue a skin-forming power which is as remarkable as it is beautiful to witness.

By these means large granulating surfaces may not only be rapidly healed, but healed without such a surface of cicatricial tissue as necessarily exists after ordinary burns or scalds, and, therefore, without that tendency to subsequent contraction that appertains to cicatrices.

This treatment has introduced us to a new field of surgery, which promises to make a large class of cases that were previously an opprobrium to our art as remediable as many minor affections.

It will receive due attention in a later page.

When a hand or finger, foot or toe, is charred, amputation must be performed; and where the soft parts are so injured as to slough, the same practice may be called for. The time and also the necessity for operation in any patient's case must be left to the judgment of the surgeon.

The constitutional treatment of burns in the first stage is to *prevent collapse* by the judicious use of stimulants and external warmth; *allay pain* by local treatment and soothing drugs, such as chloral or morphia; *maintain the powers of the patient* by simple nutritious food, such as milk, beef tea, eggs, &c.; and *after* the stage of reaction, when that of suppuration has set in, to prescribe good food of all kinds and tonic medicine.

Complications are to be treated on ordinary principles, always remembering that the injury is depressing, and requires no additional depressing influence in the way of treatment.

Thoracic complications may be dealt with by moderate doses of tartar emetic and salines, as well as nutritious and possibly stimulating diet.

Abdominal complications, with opium, alkaline remedies, such as lime water in bark, and simple diet.

For children an opiate is best given in the form of the opium ointment; while for adults, where the drug upsets digestion, the same plan is equally effective.

Scalds of the glottis will be considered in Chapter XVIII.

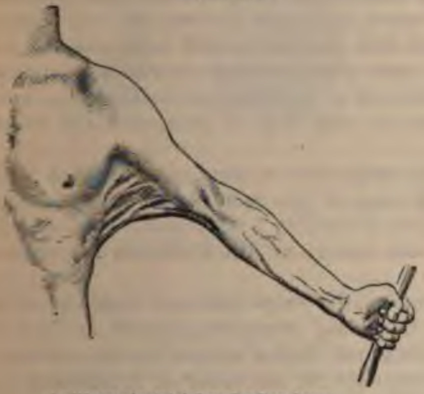
Burns and accidents from lightning rarely occur in this country, and average about twelve a year. In 1861 there were twenty-six, in 1862 twelve, in 1863 three, and in 1864 six. Holmes, who has written a careful compilation on the subject, tells us that a person struck by lightning is usually more or less completely deprived of consciousness at the time. This is sometimes a consequence of the shock given to the brain, and is accompanied by more or less paralysis of motion and of common or special sensation. Occasionally, and perhaps more usually, it is merely the effect of fright, and is then only transient. This insensibility sometimes lasts for a considerable time. The paralysis by which it is usually accompanied may last for an indefinite period; in one case it lasted four months, in another three. It is more common in the lower than in the upper limbs. Other affections caused by lightning are burns, eruptions of erythema or urticaria, loss of hair over parts or the whole of the body, wounds, hemorrhage from the mouth, nose, or ears, loss of sight, smell, speech, hearing, and taste, or, in rare cases, exaltation of these special senses, cataract, imbecility, or abortion. It sometimes leaves arborescent marks on the body even on parts covered by clothes, which have often been described as a kind of photograph of neighboring trees or other subjects. Persons not killed on the spot usually recover, though some die from exhaustion; recovery can be hastened by tonic treatment; and galvanism is beneficial in paralysis. Burns caused by lightning are deep and obstinate; sometimes, however, they are mere vesications; and should be treated as other burns.

In sudden deaths from lightning the shock of the brain is the cause; the heart is found flaccid and empty, the blood sometimes coagulated; and Taylor tells us, from Sir C. Scudamore's experiments, that in animals killed by electricity the same conditions existed.

THE DISEASES AND TREATMENT OF CICATRICES.

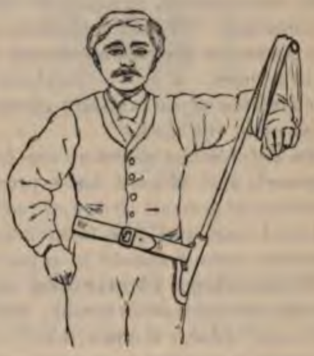
Cicatrices or scars however produced, grow with the growth of the individual, and, at the same time, have a tendency to disappear, so that indurated scars may indeed, in time, become non-indurated. In small scars this is often observed, and even in larger it is so occasionally, the large cicatrices of burns becoming soft and pliable. As often as not, however, the opposite occurs, and the disposition to contract is very formidable, producing deformities of a frightful kind; those of the neck being, perhaps, the most hideous. The arm may be fastened to the side (Fig. 40), and I have seen in one case the head of the humerus displaced forwards beneath the clavicle, and in a second beneath the coracoid process and the development of the upper extremity arrested by the contraction. There is no limit indeed to the effects of such a powerful and constant force as that of cicatricial contraction.

FIG. 40.



Axillary cicatricial web after burn.

FIG. 41.



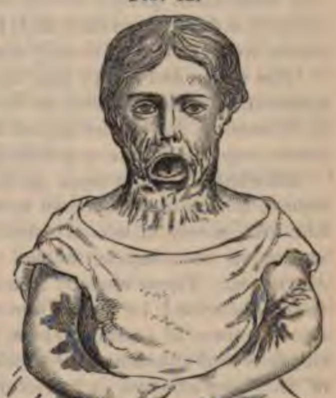
Mode of applying extension after its division.

The surgeon is called upon not unfrequently to remedy these defects, and where his efforts are successful, the surgery is satisfactory, but too often the result is far from what is required.

The operation consists in the free division of the cicatrix and its subjacent tissues, the subsequent extension of the divided parts during the healing process, and the transplantation of different centres of "cutification" during the granulating stage, after the method of Reverdin.

In dividing the cicatrix the incision may be directly across the scar, running into healthy tissue on either side, or in the form of a natural or inverted V, according to the line of induration, the V flap being dissected from the tissues beneath; or a number of small incisions may be made, subcutaneous or otherwise. But in all these divisions the surgeon must remember that the seat of the contracting cicatricial material is in the subcutaneous tissue as well as in the skin, and that unless it also is divided no permanent good can be expected. It is on this point, and indeed upon it alone, that a prognosis can be based. The most favorable cases for operation are those in which a web of tissue connects an extremity with the body, or the chin with the chest, for such a web contains within itself most of the cicatricial material upon which the deformity depends, and on its division the whole will be freed. Great care is needed, however, in the division of these webs, for they often contain important parts, such as nerves and vessels that have been displaced by the contracting process. Thus, in treating a case in which the right arm was fixed by a web from the axilla and elbow to the chest, the web seemed to be so cutaneous that I was half tempted to perforate with my knife and slit it up. Had I done so, in the position I had noted, I should have passed

FIG. 42.



Effects of burn on neck, contraction of cicatrix.

my bistoury across the brachial plexus, artery, and biceps muscle—these parts having been completely drawn across to the thorax by the affection—and then been forced to amputate the extremity. I did, however, what I should always advise others to do—divide the parts carefully and deliberately, and thus steered clear of any harm. I brought also a piece of healthy skin from the posterior part of the wound and fixed it to the anterior, about the lower border of the axilla, thus dividing the large exposed surface by a bar of healthy integument, and kept the arm at a right line to the shoulder with a splint extending from the elbow to the hip. When the wound had assumed a healthy aspect I inserted ten pieces of skin the size of hemp-seed, and after this, cicatrization went on with wonderful rapidity, the child recovering with a natural arm and movable cicatrix. In this case I have fairly indicated the points upon which a successful operation is to hinge: Free but deliberate division of the cicatrix and subcutaneous tissue; extension from the first during the healing process, by some fixed mechanical appliance; and skin transplantation when the surface of the sore has assumed a healthy granulating surface; the surgeon, where he can, partially detaching a piece of integument from one side and connecting it with the opposite, in order to divide the wound, and thus increase its skin margin for granulation. Where a bend in a joint exists this practice is still more valuable. After the operation the wound should be dressed with oiled lint and covered with cotton-wool, as in a burn. Fig. 41 illustrates a simple method of applying extension of the arm after the division of an axillary cicatrix of great size, and Fig. 42 illustrates the effects of a burn upon the neck.

In *deformities affecting the jaw*, in which immobility of the bone has been produced, Esmarch and Rizzoli have proposed the division of the bone at the fixed side and the excision of a small wedge of bone, with a view of making a false joint. The operation is a sound one, and has been accomplished successfully by Mr. C. Heath and others. In suitable cases it should be repeated.

Ulcerating cicatrices are not uncommon, for "new cutis and new formed granulations are neither so strong, nor have they the living principle so active in them as the old cutis" (John Hunter, 1787), and an old scar may break up and become the seat of an indolent sore when its possessor has been weakened by any fever or exhausting process. I have seen this repeatedly occur in cicatrices received in infancy of adults as they become old or feeble. In one case the cause of the scar was a burn, in another an injury, in a third an operation, but in all, the scars were alike, and they underwent the same degenerating process. These sores require to be treated by rest and local stimulants, the patient receiving tonics and good food to improve the weakened powers. In one case I transplanted with complete success. These "cicatricial sores" are, however, always obstinate, those over the ends of bones being unusually stubborn.

Warty and cheloid scars are classed together, because it is difficult to distinguish the indurated, lumpy, warty scar from the true cheloid. The former, however, appears directly *after* the wound has healed, and is clearly connected with the healing process, while the latter attacks any scar at any period of its existence.

The thickened warty scar appears as an induration of the whole cicatrix and is often associated with heat and irritation. It is best treated by local stimulants, such as iodine or blistering fluid—the object being to break up, by some local inflammatory process, the lowly organized fibrous production.

Cheloid tumors grow as indurated smooth tubercles, at first having a red or pinkish colors, but as they increase becoming pale. They are at times painful, or, at least, irritable, and rarely attain a large size. They had better be left alone, for they are apt to return in the cicatrix formed after their removal. Cheloid tumors generally grow from cicatrices. These cheloid tumors are known as those of Alibert, to distinguish them from those described by Dr. Thomas Addison, who in 1854 ('Med.-Chir. Trans.') described another form of cheloid which he calls the "true chenoid," the induration beginning in the skin and subcutaneous areolar tissue, and often going on to produce such a contraction of the part affected as to resemble the indurated cicatrix of a burn. Figs. 43, 44 represent the two affections.

The cheloid tumor which follows the perforation of the ear for an ear-ring is a curious form, and seems less liable to return than others of a like nature; and from the deformity it causes it should be excised with a portion of the healthy lobule.

Cancer may attack a scar, but when it does so the scars are generally old. Thus, I have treated a man who had a cancerous lip, the disease having developed in a scar he had had for fifty years. It began as a thickening of the scar, and then showed itself as a tubercle, which grew, broke down, and ulcerated, the ulceration rapidly spreading. Cancers in cicatrices mostly appear after this fashion, are usually epithelial, and are to be treated by the removal of the growth.

Fig. 43.

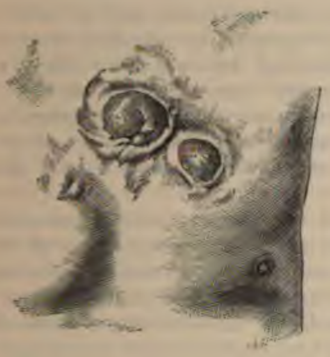
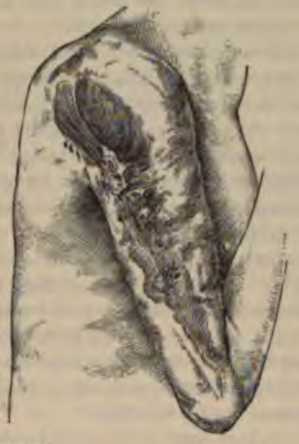


Fig. 44.



(From models in Guy's Museum.)

Cheloid of Alibert.

Cheloid of Addison.

In December, 1871, I was called upon to amputate above the knee in a man, æt. 58, a leg stump that was the seat of a frightful cancerous disease which had existed for two years, and had appeared in the cicatrix of an old amputation performed fifty-four years before for gangrene after fever (Fig. 25).

Painful cicatrices are often due to the divided ends of the nerves being bound in by the cicatricial tissue, and as often as not they are caused by a bound-down bulbous growth at the extremity of a nerve. In a case I had some years ago the external popliteal nerve, as it wound round the head of the fibula, was so bound down by the cicatrix of a burn as to cause severe agony in the whole course of its distribution. The symptoms were relieved by two free vertical incisions through the cicatrix, and the patient recovered. Should I ever see a similar case I shall pursue the same course, except that I shall subsequently transplant pieces of skin in the wounds as soon as they assume a healthy appearance. When the pain is due to an adherent or bulbous nerve, the nerve must be freed and removed. When doubt as to its condition exists, Mr. Hancock's suggestion may be adopted, to divide subcutaneously the suspected nerve. Where no such causes as have been mentioned are to be made out, the case may be treated as one of neuralgia by full doses of quinine, arsenic, or iron, and local sedatives, the extract of stramonium or belladonna rubbed down with glycerine being good applications. Cases, however, of painful stumps or cicatrices are sometimes met with, that defy treatment.

Congenital cicatrices are met with in practice. Thus, I have seen on two occasions a woman who had a cicatrix in her upper lip as if she had been operated upon for harelip (Chapter XII), and bridles connecting the lip with the gum in an unusual manner are not uncommon.

ON SKIN GRAFTING.

When John Hunter a century ago succeeded in transplanting the spur of a young chicken from its leg to his comb, as well as into the comb of a second bird, and found that it not only lived, but grew, he probably never dreamt in any flight of his genius that the fact which he then established would be so applied in the practice of surgery as to mark an era in its progress, and to bring a class of cases which surgeons were apt to look upon with little interest amongst the most curable and tractable of local affections. And yet this has come to pass, M. Reverdin, of Paris, on October 16th, 1869, having succeeded in transplanting small portions of skin taken from one part of a man's body to the granulating surface of a large sore, under which treatment the ulcer healed. He read the case before the Surgical Society of Paris on December 15th, 1869, and asked, "Is the growth of skin due to the effect of contact or neighborhood, or is it due to proliferation of the transplanted elements?"

Mr. G. D. Pollock, of St. George's Hospital, encouraged by M. Reverdin's success, followed up the practice, and the good results he and his colleagues obtained soon induced all other surgeons to follow in their wake. The facts can be read in the 'Transactions of the Clinical Society' for 1871, and at the present moment it may be considered as a well-established practice.

Since its introduction I have very extensively carried it out, and in most instances with success. I look upon the suggestion as very valuable, its adoption rendering many cases curable that were not so previously, facilitating the cure of as many more, and giving interest to a class of patients in whom formerly there was but little. In the management of ulcers it is a great boon, while in the treatment of the large granulating surfaces so common after extensive burns, its value cannot be overestimated. As an adjuvant to many plastic operations, more particularly on the face and in the case of deformities, it is invaluable.

Under the action originated by the transplanted fragments of skin, a process of repair goes on which at first appears almost magical; the grafts soon become islets of skin, round which cicatrization proceeds; the margin of the sore receives an impulse in cicatrization, which rapidly extends; and, between the grafts themselves and the margin of the sore connecting links of new skin rapidly form, which divide the sore into sections (Fig. 47). By these means large surfaces speedily cicatrize which under former circumstances would have required many months.

Moreover, the contractions and subsequent deformities that under other conditions were too well known to follow in such cases do not occur.

The practice seems applicable wherever a large granulating surface exists, and in its adoption the only desirable point to observe is, that the *surface of the sore should be healthy;* this clinical fact includes another—that the patient's health is good, for there is no better barometer of health than a sore, its surface assuming a healthy or unhealthy appearance with every alteration in the general condition of the body. I have attempted, however, by way of experiment, to graft skin upon sores that were not quite healthy, and have sometimes succeeded. In some indolent sores in which a small patch of healthy granulations sprang up, I have succeeded in securing a new centre of "cutification" by transplanting which proved of great value in aiding the healing process; in some others the graft has been enough to excite a more healthy action in the sore; still in many poor success followed the practice. It may, therefore, be accepted as a truth, *that a healthy granulating surface is an important although not an essential requisite for success in skin grafting.*

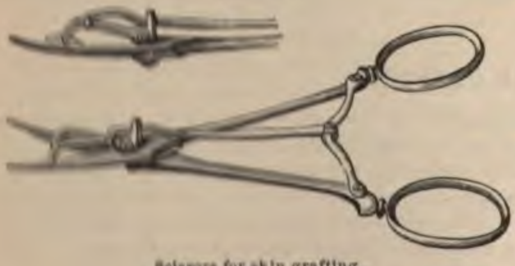
Upon this basis I now proceed to consider how the operation is to be performed.

Pollock tells us that Reverdin's method is to remove a very minute portion of the skin, place it on the surface of the granulations, and there retain it with a strip of plaster. He writes, "I have usually removed the skin by nipping up a very small portion with a fine pair of forceps, and cutting it off close with sharp scissors. At first I made a slight cut in the surface of the granulations and then imbedded the piece of skin; but of late I have only laid it on the surface of the ulcer. I cannot say that I have found any difference in the result. I do not think there is great, if any, advantage to be gained by the transplantation of a large piece, but where the ulcer is large I think much is gained by the transplantation of numerous small pieces. The disadvantage of transplanting a large piece is the sore it creates; while the small sores formed by the removal of the minute pieces heal in a short time, and without trouble." ('Clin. Soc. Trans.,' vol. iv.)

My own experience in every point confirms that of Pollock.

For the removal of the sound skin I employ a pair of scissors (figured above) which Messrs. Krohne made for me after McLeod's suggestion in a medical journal, and I find they answer far better than anything else, inasmuch as they take away a portion of skin that will cut into three or four pieces, and the section includes only the upper layer of the true skin, with the rete

Fig. 45.



Scissors for skin grafting.

mucosum. They do not cut into the fat beneath the skin, nor divide the papillæ sufficiently far to draw blood or to give pain. Patients never object, with this instrument, to a second or third piece being taken away, should it be deemed necessary. The skin may, however, be removed with a fine lancet, either by perforation or after its elevation upon the point of a needle. I generally take the skin from the fore part of the arm or the side of the thorax.

Having taken away the skin, the fragment should be cut into three, four, or more pieces, and these placed about *half an inch or three quarters of an inch from the margin of the sore, and about one inch apart;* for there is no doubt that the engrafted centre has a stronger influence in exciting a healing action in the margin of the sore when placed near it, than when isolated in the centre of a granulating surface.

The pieces should be placed upon the granulations, and gently pressed in. There is no necessity to wound the granulating surface. They should be covered with a piece of oiled gutta-percha skin, and the whole supported with cotton wool; a bandage being subsequently applied, so as to press moderately upon the part, and keep the dressing in position. On the third day, but not before, the dressings may be removed with the greatest care, and a fresh piece of oiled gutta-percha skin should be subsequently applied.

The appearances of the engrafted pieces on the removal of the first dressing vary considerably. At times they will seem palpably to have taken root and be alive; at others to have disappeared altogether; whilst in a third class the surface of the cuticle will be seen floating, as a thin film, upon the secretion of the sore, the basement membrane of the cuticle—the essential part—being left (Fig. 46).

Fig. 46.

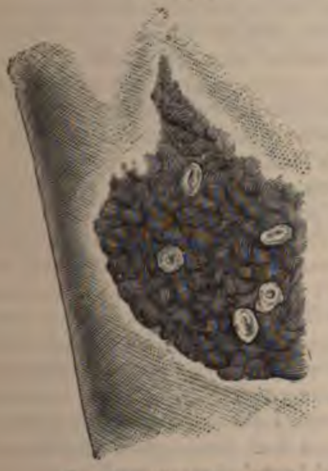
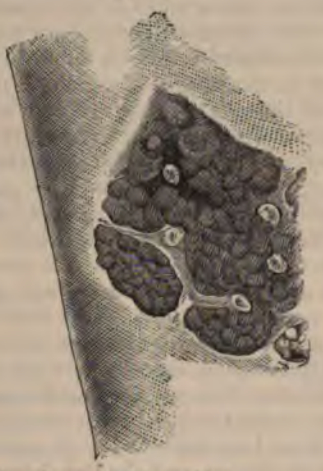


Fig. 47.

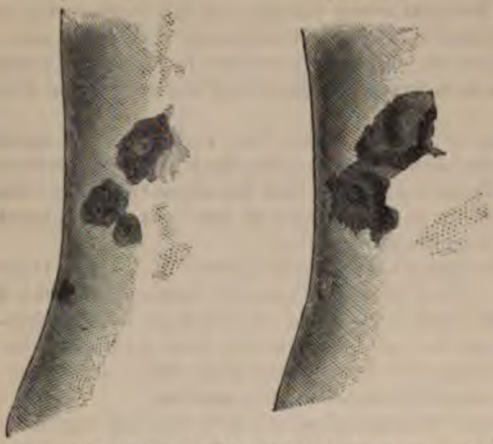


Drawings illustrating the cicatrization of sores by skin grafting.

Under all these circumstances, however, the surface of the sore is to be cleaned with the greatest care, a stream of tepid water, from a dressing can or squeezed from a sponge over the part, being the best means to employ. The surface is on no account to be wiped, for the grafted portions of skin are easily uprooted, whilst those that seem to have died or that have disappeared often show themselves again later as "cutifying centres." As soon as the sinew centres are established in large sores, other pieces should be engrafted, at about the same distance from the new pieces as those were originally inserted from the margin of the sore; and in this way the whole granulating surface may be speedily covered with new skin, and a rapid recovery follow.

How the engrafted pieces act in the healing process is not yet satisfactorily settled, and Reverdin's questions, already quoted, have not yet been completely answered. That hey do act as direct stimulants to the sore itself and more particularly to the margin of he sore, there can be little doubt, for as soon as the "grafts" have taken, the margin of he sore nearest to them is seen to cicatrize and to send out prolongations of new cicarizing tissue to meet similar prolongations from the new cutifying centres: the sore in his way becoming subdivided by bands into smaller sores, and then rapidly healing (Fig. 7).

Fig. 48. Fig. 49.



Drawings illustrating the growth of black skin when grafted on to the sore of a white man.

That the engrafted portions grow by the proliferation of their own cells is likewise proved by the fact, that in the case of a white man upon whose ulcerated leg I engrafted four small pieces of black skin, the whole being no larger than a barley-corn, the black skin grew twenty-fold in ten weeks, to the extent illustrated in Fig. 48, gradually enlarging and sending out prolongations which joined, till one patch of black skin had formed, as seen in Fig. 49. The ulcer healed as rapidly where the black skin was grafted, as where the white was placed. The engrafted pieces of new skin thus grow themselves by cell development, they stimulate the skin-forming powers of the margin of the sore, and exert at the same time a like action on the granulations around.

The same result may likewise ensue when large pieces of skin, whether removed from the patient or from some recently amputated limb, are transplanted. The dressers at Guy's have frequently engrafted large pieces of skin, half an inch square, removed from amputated limbs; the pieces on removal have been dropped into warm water in their passage to the wards where they are applied. But there seems to be no advantage in this practice, and in the cases in which it has been adopted a large proportion have failed. In a case of mine the grafts took root and excited healthy action in the margin of the sore; they, however, grew but little, and remained on the cicatrix of the sore, as bosses of skin with well-marked borders. They were grafted, it is true, but the grafts seemed to have no power of assimilating themselves to the tissues on which they were placed (*vide* Model Guy's Mus.).

To take large pieces of skin from the patient's own body is an objectionable practice on account of the large wound it creates, and, moreover, is unnecessary in the majority of cases, as small pieces appear to do better. To take them from another subject is also objectionable for like reasons; but still more so, on account of the difficulty that sometimes accrues from a want of power in the new graft to assimilate itself to the tissues on which it is placed, and from the risk that is necessarily run of introducing into the blood of the living subject some new or poisonous element; a risk which I believe it to be wrong and unjustifiable to run, and that I would not allow on my own person. For these reasons I have forbidden my dressers adopting the practice.

In the case where black skin was transplanted, I did it with the full concurrence of both patients; indeed, both were rather disappointed that the operation could not be repeated. They were firm friends, and the link I formed bound them closer!

There seems, however, no objection to mincing the portion of integument which is to be employed into minute fragments, that is, into pieces the size of millet-seeds; the thumb-nail of the surgeon being the best table for the purpose. In children where it is unadvisable to remove much healthy skin, and the surface to be covered is large, the plan is excellent, though I prefer pieces the size of half a hemp-seed, when they can be obtained. The practice of applying "skin-dust," or the products obtained by scraping the skin, cannot be recommended, as it is rarely successful.

Whether this newly engrafted skin possesses the same power of resisting disintegrating changes as the old skin is not yet proved. Some observations I have made lead me to suspect, that it is in some cases rather liable to break down and ulcerate as soon as the patient begins to walk after the sore has completely healed, whilst in others I have found a sore in this way healed is more capable of resisting disintegrating changes than another healed by unassisted natural processes. At any rate, it is necessary to observe as much care in the after-treatment of the case as ought always to be observed after the cure of any other sore; and more particularly to afford moderate support and protection of the part. For this purpose there is nothing better than to bind on a piece of sheet lead over the cicatrix when the seat of mischief is on the leg, as by it equal pressure as well as protection is afforded.

The new skin soon becomes as sensitive as the old; the sensibility of the cicatrix, under these circumstances, indeed, seems to be greater than when unaided cicatrization is allowed to take place.

CHILBLAINS.

Chilblains are local inflammations of the skin, and are to be met with in subjects of a feeble circulation. They are more common in the young, and in women than in men, and are generally seen on the toes, fingers, nose, or ears, and are caused by any sudden change of temperature or any sudden application of cold or warmth.

They are simple congestions of the skin attended with tenderness or itching; vesication of the skin, when the inflammation is more severe; or sloughing and ulceration of the skin, when a broken chilblain occurs. The disease may begin and stop at the first or congestive stage, or run through all the stages—the experience of each subject telling him or her what is to be expected.

Towards evening the symptoms of irritation are always increased, and any external warmth, as of a fire or bed, any full diet or stimulating drink aggravates it; in fact, anything that excites the circulation in the part, at any hour of the day or night, is apt to increase the symptoms.

TREATMENT.—The local treatment of chilblains is no less important than the general, and more successful; for whilst tonics, good diet, external warmth, and exercise are necessary to improve the general powers of the patient and the circulation, local stimulants are of great value. When the chilblain is not broken, the local application of the tincture of iodine, of a solution of sulphate of copper (three grains to the ounce), of camphor liniment, of soap liniment with opium, or one-fourth part of the tincture of cantharides, of compound tincture of benzoin, or of simple spirit, not only gives comfort, but hastens the cure of the disease. The parts should also be covered with strapping spread on leather.

When the parts are broken, water dressing with the use of thick lint and oil silk or elastic tissue, are the safest remedies, stimulating lotions being used later when the parts are indolent in healing. Olive oil ℥ij, Acid. Carbolic. gr. x, and Ext. Opii ʒj, is a good formula.

Warm socks and loose shoes or boots are always indicated, but anything like pressure is most detrimental. Exercise also should be taken when possible, and an equal temperature ought to be maintained.

FROSTBITE.

It has already been shown, that the sudden application of cold to any exposed part of the body of a feeble or depressed subject is liable to be followed by "*chilblain;*" and, when concentrated cold is applied, under these circumstances, for a period sufficient to arrest the circulation in a part, a "*frostbite*" is the result. Sudden and severe alternations of heat and cold under exposure, however, even in healthy subjects, may produce this result, and, in military life, this fact is well known.

The first effect of cold upon a part is, a sense of numbness and weight with a feeling of tingling. To the eye the skin will probably appear redder than usual, and if the part be removed from the influence of the cold at this time, recovery may follow, or, in feeble subjects, a superficial "*chilblain.*" If the cold, however, be allowed to act longer, the parts will become stiff, and at last insensible, feeling "dead." To the eye they will assume a white and waxy aspect and be senseless to all impressions, the blood having been completely driven from the surface. When the cold has been suddenly applied, and is sufficient to kill the structure outright, the frozen part will have a mottled aspect, from the retention of blood within the tissues. Many of these effects may be produced by the ether spray.

The *constitutional effects* of cold are at first stimulating, and subsequently depressing; excitement passing into sleepiness, and this into torpor. If the latter be yielded to, the sleep will end in death, the blood being sent from the surface of the body to the brain and other viscera, and death being produced by blood engorgement, as in apoplexy.

In the "sleepy and depressed stage" of cold, if the patient be brought suddenly under the influence of warmth, and placed too near a fire, the risks of lung engorgement, as well as of rapid gangrene of the frozen parts, are very great, for by sudden reaction the arterial circulation becomes quickened, and all the parts are gorged with blood which they have lost the power of propelling onwards. In gangrene from frostbites there seems reason to believe that ulceration of the duodenum may follow, as after burns. Mr. Adams has recorded such a case in the 'American Med. Times' for 1863.

TREATMENT.—Few cases require more care, for any sudden alternation of temperature may be most injurious. The aim of the surgeon should be to recall the affected parts *gradually* to their normal condition, by assisting the venous circulation by gentle friction in the course of the veins with furs or flannel, and the arterial by comparative warmth applied externally, and gentle stimulants administered internally. Neither warm water, nor air, nor fire should be allowed to approach the parts until the natural temperature has been partially restored, and then only with great care. Friction with snow or iced water has been recommended. On reaction, the parts may be raised and lightly covered with flannel or cotton wool, or exposed to the warm air of a chamber; whilst food and stimulating drinks are carefully administered, warm milk with a little brandy being the best. Should reaction be too severe, it must be checked by lead or spirit lotions.

When gangrene follows, and only *small* portions of the body suffer, such as the integument, the parts may be dressed by some stimulating application, to hasten the separation of the slough, and the part should be kept warm; carbolic acid and oil are probably the best applications; tonics should also be given.

When *large* portions of the body suffer, such as the whole foot (and in this country I have seen a coachman, who had on new tight boots on a bitter wintry day, lose both feet), amputation may be called for, the surgeon always waiting till the line of demarcation or limit to the sloughing process is fairly marked.

BOILS AND CARBUNCLE.

These affections are, in a measure, allied, and are both due to inflammation of the skin and subcutaneous tissue, though the disease probably commences in the latter. In both there is effusion of lymph into the areolar tissue of the part, and in both this generally sloughs, although in the boil, the slough is local and confined to one central point, while in carbuncle, the process may cover an extent of integument varying from the size of half a crown to that of a plate.

Boils are met with in two forms: *one* as a subcutaneous swelling, attended with little pain until the skin over it inflames and suppurates. It then appears as a conical-pointed swelling, with inflamed indurated areola; this causes severe distress, until the parts give way, when the feeling of tension and throbbing is followed by relief due to the termination of the sloughing process, and discharge of the "core." When the slough has been discharged, an irregular orifice in the skin is seen covering in a cavity in the cellular tissue, which subsequently granulates, leaving a depressed cicatrix. The core or slough is composed of skin infiltrated with lymph.

The *second* form of boil begins as an inflamed follicle or pimple, which occasionally becomes vesicular, and has a scarlet, exquisitely sensitive areola. It suppurates slowly, and, as a rule, terminates with a less well-marked slough than the former kind. Such boils are more usually multiple than the other, and are often caused by the application of moist dressings, or of some cadaveric irritant.

With respect to the *causes of boils*, nothing definite can be laid down. That they are always associated with some debilitating or allied cause is belied by daily experience, for they are certainly often seen in men and women in whom no such condition exists, and in subjects who often declare that they "never felt better in their lives." As a rule, however, this is not the case, because they more commonly occur in subjects who have either been fed to excess or been subjected to some sudden change in the nature of their diet; such for instance as in men who undergo training for athletic pleasures, or who are subjected to the influence of fetid animal exhalations, as met with in a skin-yard, pathological room, or dissecting room. They are seen also in the diabetic and cachectic subject, as well as in patients enfeebled by any fever or other debilitating cause. Gamgee tells us that they are often the result of eating diseased meat. They are also produced by the local contact of certain cadaveric emanations; the newly appointed post-mortem clerks of our hospitals often falling victims, the poison acting at first as a direct irritant upon the follicles to which it is applied. They are far more common in some years than in others. In persons who are predisposed to their formation any local irritation is apt to produce them, such as the friction caused by rowing, the application of a poultice, water dressing, strapping, or a blister. They attack the integument of any part of the body, the palms of the hands and soles of the feet being apparent exceptions.

In the dense integument of the nape of the neck, buttock, and outside of the thighs, they are more chronic and painful than in the skin or looser texture. They are troublesome local affections, but seldom endanger life. In rare instances they are followed by septicæmia and death, but only in one instance have I known this to occur.

TREATMENT.—The general treatment must depend upon the condition of the body and the apparent cause of the complaint, any unwholesome habit being corrected, and any evident want supplied. Under other circumstances the practice must be directed on general principles. The diet should be nutritious, but not too stimulating, exercise short of fatigue should always be allowed, and fresh air obtained when possible. The secretions should too be looked to, and, when out of order, corrected, mild laxatives being often of service. When the skin is secreting unhealthily, the Turkish or warm bath is of great benefit; moreover alkalies or acids ought also to be given when the condition of the stomach needs them; alkalies and bitters are often of great benefit.

When debility exists, quinine is invaluable, and in London or large towns, its combination with iron is required. When diabetes is present, the "feeding" treatment is probably the best. Dr. Jackson, of the United States, gives twelve to sixteen grains of quinine a day, increasing the dose daily until its special effects are produced, and then decreasing it. He continues the treatment for a month. Yeast in doses of a tablespoonful, taken fasting three times a day, occasionally appears to have a rapidly marked beneficial effect, although in what way it acts it is difficult to say.

The local treatment must be directed much by the local symptoms, it being, as a rule, a better course to let the boil discharge itself or dry up than to lance it. In the early stage of the papular or follicular form of boil, the free application of alcohol, spirit of camphor, the nitrate of silver, liquor potassæ, or iodine tincture, is often followed by its disappearance; but in the other kind all such applications are worse than useless.

When the pain is great from the tension of the part, and the areola of inflammation is spreading, relief may generally be given by lancing, and when the slough is slow in separating, the introduction into the opening of a point of potassa fusa is followed by the rapid cleansing of the wound and granulation. Poultices may be applied for a limited period during the sloughing stage, but not for any length of time, as they often encourage the appearance of others; water dressing is, however, generally preferable. When the local inflammation is not great, the plan of covering the boil with a piece of plaster with a hole in the centre, is very beneficial. At times, painting the areola with collodion or colloid styptic answers well. When boils succeed one another *seriatim*, without any definite cause, change of air is a most successful remedy.

CARBUNCLE.

This is a far more serious affection than a boil, for it is almost always met with in the feeble and cachectic subject, and generally in men, rich or poor, over forty-five. It is very frequently associated with diabetes, and gouty patients are particularly prone to the attack.

It generally occurs singly, and is slow in its progress, the inflammation in the skin and cellular tissue beneath spreading as a brawny inflammatory effusion, with no defined border. The redness of skin is rarely vivid, more frequently livid; at times the local pain is severe, and constitutional depression very great. The sloughs separate slowly, many openings, as of many boils, allowing them to escape, and the whole skin at times separates as an ash-colored layer, leaving an irregular cavity undermining the neighboring tissues. The favorite seats of carbuncle are the skin and subcutaneous tissue of the nape of the neck, back, and buttock. They occur, however, on the front of the body and the extremities, and at times on the lip or face. The disease is so slow in its progress as at times to occupy many weeks, one part going through its course while the disease spreads in another. It may destroy life by exhaustion or by pyæmia; the worst form of pyæmia arises from it; indeed, M. Labat ('Med.-Chir. Soc. Bordeaux,' 1868) believes pyæmia to be the most common cause of death in carbuncle. Rare cases have been recorded in which peritonitis was caused by the extension of the disease from the abdominal walls into the peritoneal cavity.

When the treatment by incision is adopted, life is too often shortened by loss of blood. As a general rule, however, carbuncle is not a fatal disease. Its danger depends much upon its extent, and more upon the complications with which it is associated.

TREATMENT.—In former days the one form of local treatment that every surgeon followed was that of the crucial incision +, the knife being passed freely through the tissues to the base of the inflammatory effusion; the object of this was to give room for the slough to separate and come away. In modern times the value of this practice has been much questioned, for it was too often found to be followed by loss of blood, where blood was much needed; nor has it been thought that the incision did much to hasten the progress of the case or the separation of the slough. It is still, however, a popular form of practice. I was taught it, but after observing its effects have long given it up, believing that it did little or no good, and was often followed by a harmful hemorrhage.

The treatment I prefer, and have adopted for many years, has been that by caustic, and the more I see of it the better I like it. It has been strongly advocated in this country by Pritchard, and in America by Dr. Physic. It is applicable in the stage of the disease when the cellular tissue is brawny, and the early inflammation of the skin has subsided; it may be used before any openings in the skin are found, either as Pritchard advises, by rubbing the caustic potash freely in the centre of the carbuncle until an eschar is fully formed, or, which is preferable, by puncturing with a scalpel, and inserting the stick or a small piece the size of a pea well into the diseased tissues. When the carbuncle is large, many punctures may be made, one to every area of surface of the dimensions of half a crown. Where openings exist, the surgeon has only to insert the caustic and allow it to melt, either in the stick, or, what is better, in pea-like masses, by means of dressing forceps, passing them well down into the subcutaneous tissue. By this practice the slough is certainly cast off more readily than when incisions are made or the case left to nature. No bleeding takes place, and very little pain is given excepting at the time. With this treatment large carbuncles become soon healthy granulating wounds. The only care required is, to prevent the caustic running over the sound skin. During this treatment a poultice may be applied, or some lotion, such as Condy's fluid, carbolic acid, or alcoholic lotion; a solution of opium applied to the part often gives relief to pain. Tonics, good living, and fresh air, are also essential. The French surgeons prefer the use of the Vienna paste. By these means, unless the carbuncle is associated with some serious malady, such as diabetes or pyæmia, a good result may be looked for.

The plan of making a subcutaneous incision has been ably advocated by Mr. French and M. Guérin, and that of compression by Messrs. O'Ferrall and M. H. Colles, of Dublin ('Dub. Quart. Journ.,' 1864). The former plan I have tried, but have failed to find its advantage. The latter I have not employed, having been already well satisfied with the caustic treatment.

M. Gosselin strongly advocates the plan of making deep punctures into the carbuncle and evacuating them by means of compression.

The best thing, writes Paget ('Lancet,' 1869), you can do, if the carbuncle is small, is to cover it with emplastrum plumbi spread on leather, with a hole in the middle through which the pus can exude and the slough can come away. When the carbuncle is large he advises the common resin cerate, and over it a linseed-and-bread poultice; perfect cleanliness is to be observed during the sloughing process.

Facial Carbuncle.

This has been often miscalled "malignant pustule." It was probably first described by a clever young surgeon, Harvey Ludlow ('Med. Times and Gaz.,' Sept. 1852). It is generally found on the lip, the upper one being the more commonly involved, as an œdematous inflammatory swelling of the part, involving the nose and cheek, often preceded by some pustule or vesicle, and generally accompanied by them. It is almost always associated with severe pain. It ends, as do most cases of carbuncle, with sloughing, and at times the whole substance of the lip or cheek gives way. It is associated, like carbuncle, with great constitutional depression, and its special danger is thrombosis and phlebitis of the cerebral sinuses; the inflammation of the veins extends from the affected parts through the ophthalmic veins to the cavernous sinus. I have seen six cases of this affection, four of the upper and two of the lower lip, and all recovered. In only one did the disease extend beyond the lip, while in all, the disease, as far as local treatment was concerned, was left to natural processes, cleanliness and fomentations being alone employed. Tonics and good diet were given, and quinine with iron, in full doses, appeared the best. Paget advises quinine in sufficient doses to produce symptoms of cinchonism.

M. Reverdin, interne des hôpitaux, gives a very elaborate essay on this subject in the 'Archives Générales de Médecine,' 1870. At p. 162 of the August number he thus sums up his conclusions:—

1. Anthrax and furuncle of the face present a special gravity.
2. This gravity is due to the ready complication with phlebitis.

3. The facial phlebitis is attended with death, either by extension to the sinuses of the dura mater, or by becoming the source of purulent infection.

4. Of anthrax of the face, that of the lips is more frequently complicated with phlebitis than the others. This may be explained by the peculiar texture of the lips.

5. Anthrax of the lips has nothing in common with malignant pustule.

6. The involving of the orbit in the phlebitis, as demonstrated by exophthalmia, shows almost for certain the implication of the sinus.

7. Incision, speedily and extensively performed, seems to be the best means of preventing and sometimes of arresting the phlebitic complications.

MALIGNANT PUSTULE OR CHARBON.

This is a disease of which I have had but slight personal experience. M. Bourgeois, in a work entitled 'La Pustule maligne et Œdème malin' (Paris, 1861), has given a full description of it. He tells us it is derived from an animal poison, and that it is communicated to man by direct contact with the body of a diseased animal, or with any material that has been in contact with the disease. It is found chiefly on the exposed parts of man, such as the hands and face, and begins as a small, red, inflamed, and itching spot, which in twelve or fifteen hours vesiculates, the skin beneath the vesicle appearing as a dry brown or black slough. In the course of the second day, another crop of vesicles appears around the original seat of the disease, which run the same course. About this time the seat of the original disease becomes more swollen, appearing as a defined lump ("bouton"), the parts around being œdematous, and the whole subsequently sloughing. In this stage of the disease there is little pain, the slough is always *dry, and there is no pus;* the sloughing spreads from the skin down to the subcutaneous tissue instead of as in carbuncle, from the latter to the former.

Malignant pustule is also rapid in its progress, four to nine days seeing its end. It is usually ushered in with rigors and symptoms of depression, followed by vomiting and *great* depression; often cold sweats and delirium occur, and the patient dies from the depressing influence of the animal poison before its local effects have had time to work. In young subjects, the prospects of recovery are greater than in the old, and, when the hands are involved, the chance is better than when the head is affected.

TREATMENT.—The disease being in its nature local, local treatment is to be preferred, and Bourgeois tells us, that the free application of some caustic, such as the potassa fusa, so as to destroy fully the primary vesicles in their early stage, is the best treatment; and, in more advanced cases the excision of the slough and the free use of same caustic is to be recommended. Tonics, diffusible stimulants, and such means as are usually employed to guard against the tendency to death, are of great value.

PERFORATING ULCER OF THE FOOT.

This affection was so called by Vesigné of Abbeville in 1850. It is an affection which Mr. Hancock has brought prominently before us in an able paper published in the 'Brit. Med. Journ.,' June 26th, 1869, although Cloquet, Boyer, and Nélaton, of Paris, have also described it. Nélaton says it "commences with phlyctæna in the pad of the foot. The epidermis is raised by a small quantity of purulent serum. Others describe it as commencing like a flat corn, which ulcerates. When this is opened, the subjacent dermis appears of a rose color, and when touched is highly sensitive. This state may continue for some time, when the dermis in its turn gradually ulcerates, and a small fistulous opening is established in the subcutaneous cellular tissue, which will not heal, but continues to discharge serum slightly tinged with pus. If after five or six weeks the sinus is examined by a probe, the subjacent bone is felt rough and necrosed, and a sequestrum subsequently forms."

The disease is probably hereditary, and is most obstinate in its character, generally spreading over years. It is, however, chiefly local, and confined to the anterior portion of the foot. Medicine has little power over it, although Fowler's solution has been much vaunted for its cure, still with insufficient evidence, and, as far as facts can guide us, it appears Hancock's conclusion is the only right one, and that is, that in the first instance, when dead bone exists, it should be removed. "But if, notwithstanding, the disease returns, there can no longer be a question that when once perforating ulcer of the sole of the foot is established and recognized, it is better at once to remove the whole of the metatarsal bones, either by Chopart's, Syme's, or Pirogoff's amputation."

These cases are not to be confused with the suppurating bursæ or bunions found in feet deformed from short or tight boots.

ORIENTAL SORE.

The Oriental sore, which includes the Delhi boil, Moultan sore, Aleppo boil or Biskra bouton, seems to be due to the use of brackish, hard well-water (the Delhi well-water containing 45 to 50 grains of carbonate of lime per gallon); rather than to the presence of an animal parasite, as suggested by Messrs. Alcock and Fleming, of the Indian Army ('Med. Rep.,' 1868). It shows itself, says Sir J. Fayrer ('Practit.,' October, 1875), as an "intractable, indurated, indolent sore, papular in the early, encrusted or fungating in the advanced stages; spreading by ulceration of skin, single or multiple, often occupying extensive surfaces of the exposed parts of the body," and its secretion contains minute cell-growths, by which the disease is propagated. It may attack dogs and horses. Messrs. Lewis and Cunningham ('Appendix to 12th Report of Sanitary Commissioners with Government of India') assert, however, that the disease is of the nature of a lupus, and should be treated as such. Indeed, they describe it as "lupus endemicus," 'Lancet,' April 7, 1877. It is to be treated by personal cleanliness, the avoidance of the use of *hard* water, the early destruction of the sore by the cautery or caustic, and the application of metallic astringents. Tonic treatment, a good diet, and if possible change of locality and climate should be secured.

MYCETOMA OR THE FUNGUS DISEASE OF INDIA.

This disease has been described by Dr. Carter, of Bombay, in the 'Trans. of the Med. and Phys. Soc.,' Bombay, 1861, and in a memoir published by Churchill, 1874, and is supposed by him to be due to the presence of a fungus. Other authors have thrown doubt upon this point, and amongst them F. B. Lewis and D. Cunningham, of Calcutta, who conclude that it is reasonable to infer that localized spots in the tissues undergo degenerative changes into a substance peculiarly adapted to the development of filamentous growths, the origin of which in situations where no spore could penetrate must remain matter of perplexity (M. J. Berkeley, 'Nature,' November 9, 1876), although the disease is well recognized. Berkeley observes, however, that the bodies found in the disease "so nearly simulate fungous growths, that it is difficult to get rid of the notion that they are really vegetable growths." ('Intellect. Observ.,' 1863.) The disease is more frequent in men than in women, and affects all classes, rich as well as poor, but it has never attacked a European.

The disease is chronic, and affects most commonly the foot, sometimes the hand, and but rarely other parts of the body. It is very slow in its progress, and has no tendency to get well if left alone. Usually it begins on the plantar surface of the foot or the palmar of the hand, as an induration in or under the skin; this subsequently softens down, a bleb then forms over the spot, and bursts, leaving a sinuous opening, from which exudes a thin sanious, sero-purulent discharge. As the disease progresses, other indurations, followed by sinuses, form, till the foot or hand becomes one indurated diseased mass, riddled with holes the orifices of sinuses which may or may not lead to bone; and in extreme cases the bones are tunnelled. These sinuses discharge freely a putrid sero-purulent fluid, containing "fungus particles." The fungi are of two kinds, each, according to Dr. Carter, marking a variety of the disease. One, the dark or dark brown, is globular or ovoid in form, hard and friable in consistence, and of the size varying from a pin's head to that of a bullet. The other is pale or yellowish in color, soft and cheesy in consistence, and of the size of a minute speck or pea. Dr. Carter and others believe that excision or amputation of the affected part is the only sound practice to be adopted.

WARTS.

These are growths of the papillæ of the skin, the papillæ being usually elongated and their epithelial covering thickened. They are common on the hands and other parts of the body of the young, and more rare in the adult. When on exposed parts of the body, they assume a horny hardness: but when surrounded with moisture or the secretion of the skin, they are soft and more sensitive.

The flat wart is called *verruca simplex*, the pedunculated *verruca digitata;* and these are said to be more common in the scalp. I have seen them on the neck, orifice of the nose, mouth, eyes, ears, and anus, also on the prepuce and labia. I have seen them also on the tongue. They occur at times beneath the nails and are very painful—*subungual.* The worst crop of warts I ever saw was around the anus of a boy.

The flat warts occasionally come and go in a way which cannot be accounted for; as a rule, they are, however, persistent. They rarely last into adult life, but when they do they seldom grow or give trouble. In exceptional cases, under some local irritation, they may increase and assume more the character of an epithelial cancer. When on the face this change is peculiarly liable to occur. Not long ago I destroyed an epithelial cancer by the ala of the nose, the size of a florin, that had suddenly appeared in a wart which had existed for sixty years, nearly all the patient's life, and I have removed from the lip of a man a cancer that had grown from a wart which had existed as long as he could remember.

Venereal warts are very abundant, whether they grow from the glans penis or prepuce of the male or labia of the female. They are pedunculated, moist, and highly vascular, and are clearly contagious. Warts, however, may occur at times in these parts without any venereal contact.

TREATMENT.—Some powerful alkali, such as ammonia, to dissolve the cuticle, and the subsequent application of the glacial acetic acid, nitric acid, or acid nitrate of mercury, to destroy the papillæ, is the best plan to get rid of the harder or flat warts. Lunar caustic is an unsatisfactory and tedious remedy. Pedunculated *dry* warts should be cut off with the knife or scissors, and the *moist* may be treated in the same way when not too extensive. When, however, they are extensive, they may be made to dry up by the application of some powder, such as the oxide of zinc, or even starch. Powdered fresh savine is a good application, Mr. T. Smith recommending it to be mixed with the powdered diacetate of copper. The perchloride of iron in tincture is also serviceable. Venereal warts and others, when extensive, may be readily destroyed by means of the galvanic cautery, the patient being under chloroform. At times excision is the best practice. In the large masses that are found on the genital organs of women, of venereal origin, nothing but the removal of the whole with the labium can be entertained; when the écraseur of the galvanic cautery cannot be obtained, the ordinary wire instrument may be used. The hemorrhage from these venereal warts is generally severe; and the surgeon should never attempt to remove them by excision, when they are extensive, without having at hand some good styptic, such as the solution of the perchloride of iron, matico, alum, dry and in solution, or the cautery in one of its forms.

MOLES.

Using the word in the broad sense to include small spots of discolored skin, and cutaneous connective tissue tumors with pigment, with or without unnatural growth of hair or skin glands, they are very common; few people being without one or more upon the surface of the body, while many have them in numbers. I have seen a woman studded all over with hairy moles, the hairs having been in some half an inch long and bristly. Moles are generally congenital, but at times put in an appearance latter in life; they are rarely of any great importance beyond the disfigurement they produce; occasionally, however, they degenerate or become the seat of a cancerous disease, the melanotic cancer having frequently its origin in such congenital spots. This clinical fact, which is now fairly recognized, is important, and renders it expedient for the surgeon to excise any mole that has a tendency to grow or to become indurated in middle life; for the melanotic is, as a rule, a soft cancer, and, when it has once appeared, is prone to spread and multiply rapidly. Many of the most virulent forms of multiple cancer the surgeon sees have their origin in moles.

CORNS.

These are thickened cuticle, the result of *occasional pressure*, whether on the toes or feet, from tight or hard boots; or on the hands, from the mechanical irritation of tools, &c. It should be remembered that they are the result of occasional, and not constant pressure, the latter causing atrophy and absorption. Not only, wrote Hunter, "the cuticle thickens, but the parts underneath, and a sacculus (bursa) is often formed at the root of the great toe, between the cutis and ligaments of the joint, to guard the ligaments below." This bursa forms under all corns when the pressure is not removed, in all old and neglected cases. A corn, when newly formed, can, by maceration, be elevated from its position as thickened cuticle only, the cutis being unaffected; but in old corns the cutis appears to atrophy, and the papillæ to disappear. Such corns, writes Mr. T. Smith ('Holmes's

Sys.,' vol. v), "may be found based upon the fibrous tissue of the sheaths of the extensor tendons of the toes, all intermediate structures having been absorbed." When a bursa has formed it may inflame or suppurate, and give rise to troublesome conditions, such as will be described under "bunion."

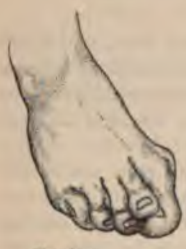
A corn is called "soft" when it forms between the toes. It is far more painful and sensitive than the "hard;" it grows also more rapidly, probably owing to its greater moisture.

Treatment.—Remove the cause and the disease will disappear. This is the doctrine which applies to corns of all forms, when acted upon early. Boots which are too loose are as injurious as those which are too tight; where one presses the other rubs, the result being the same. A well-fitting boot, with a straight inner border and broad top, is the best. To remove the cuticle nothing equals warm water; and after soaking the part in it for some time, or keeping the corn covered for a night or more with water dressing and oiled silk, the whole may be carefully peeled off by means of a knife. After the removal of the corn, the skin should be protected by a piece of soap-plaster spread on leather. The application of nitrate of silver has been recommended. I have known it produce great pain, and, when applied to an inflamed corn, much harm; indeed, in one case sloughing of part of the integuments covering the little toe; in old people it is dangerous. The application of the glacial acetic acid is to be preferred. When suppuration takes place beneath a corn it should be relieved by a puncture as soon as possible, and water-dressing applied. Bursal swellings are to be treated as bunions. Soft corns are best treated by taking away pressure by means of the introduction between the toes of cotton wool, or undressed wool, and the use of some dry powder, such as the oxide of zinc; the corn soon becoming a dry one, and easily eradicated. Acetic or carbolic acid is a good application in obstinate cases.

Bunions.

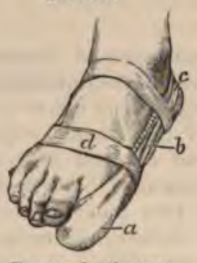
When from excessive or long-continued pressure a bursa forms over one of the tarsal or metatarsal articulations, a "bunion" is said to be present, and the most common seat for this affection is the metatarsal joint of the great or little toe. This fact is to be explained by the evil tendency which boots, as generally made, have to draw the toes together towards the central line of the foot. The central axis of the undeformed great toe being thus made to deviate from the normal line, which runs parallel with the metatarsal bone through the centre of the heel, to an abnormal one, in which the great toe itself, looking outwards, forms with the metatarsal bone at the joint, an angle pointing inwards, and the axis of the toe falls far within the normal one of the foot (Fig. 50).

Fig. 50.



Bunion.

Fig. 51.



Toe-cap for the cure of bunion.

Aston Key, however, attributes this deformity more to excessive weight received on a weak tarsus and metatarsus from over-standing; the great toe being gradually forced outwards by the oblique bearing of the foot on its inner plantar surface, when the arch of the foot has given and the foot become flat. Too short boots greatly favor this change, the foot by such being compressed logitudinally, and the arch of the tarsus increased; the toes even being drawn up to form angles with the metatarsal bones—the great toe suffering the most. When bursæ form over the projecting bones, it is to save the joints from injury, and at times these form over the dorsum itself. Under extreme conditions the bursa may inflame and suppurate, giving rise to obstinate and troublesome sores. In still more extreme or neglected cases the joint of the great toe may be involved, ending in its destruction with or without exfoliation of bone.

Treatment.—When the nature of a bunion is understood, the principles of its treatment become clear. Preventive treatment is the best, and consists in maintaining the natural condition of the foot; in young children, and in girls especially, by guarding against the flattening of the foot from over-standing or walking during the period of growth, and against altering the axis of the great toe by keeping the inner line of the boot straight; and in no way by too short boots cramping the foot longitudinally.

When a bunion exists the only consistent treatment is that which tends to restore the misplaced toes to their natural position; when the great toe is involved, either by Key's plan of having a separate compartment made in the boot, so constructed as to keep it in a straight line with the foot, or by the simple apparatus given in Sayre's work on orthopædic surgery (Fig. 51), which consists of buckskin or linen caps to the toe *a*, a few inches of elastic webbing *b*, a piece of adhesive plaster to go round the foot *c*, and two circular pieces of the same *d* to retain all in position. Even in severe cases this practice may be successful, and in the old and confirmed cases the same is to be adopted; palliative treatment, however, is at times alone practicable.

The common plan, wrote Key in 1836 ('Guy's Hosp. Rep.'), "resorted to for the relief of bunion palliates the evil, in some degree, by removing the pain, and taking off the pressure; but it does not go to the root of the evil. The plasters on thick soft leather are agreeable to a painful bunion by keeping the skin in a pliant state, and by protecting the part from pressure;" but they do not cure the disease.

Under all circumstances, pressure is to be removed; nothing like a tight boot ought to be thought of, a wide and easy one being worn. To the inflamed bunion water-dressing is the best application. Should suppuration take place, an early incision into the bursa should be made. In old people, however, some caution is called for in carrying out this practice, because in such, where from diseased arteries or other causes the circulation is feeble, gangrene of the part or a troublesome suppuration may arise. When suppurating sores exist, they may in the aged require stimulating applications; in the middle-aged, the bursa may be laid open and allowed to granulate, or be excised. In the early stage of a bunion the mechanical means suggested may be aided by the local application of a small blister, and Mr. Thomas Smith speaks highly of the local use of the biniodide of mercury, ten grains to an ounce. ('Holmes's Syst.,' vol. v, ed. 2d.)

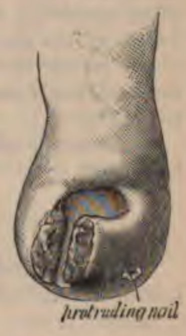
In the last stage, when the joint is destroyed, the case may have to be treated by incision of the parts, excision, or even amputation.

IN-GROWN TOE-NAIL.

This is a troublesome and painful affection, and is more commonly met with on the outer side of the great toe-nail than on the inner, though it may occur in both places. It is usually caused by external pressure upon the soft parts, the movable soft parts being pressed upon the immovable nail. As often as not, it is due to the collection of cuticle beneath the edge of the nail, this cuticle acting as a foreign body and by its pressure causing ulceration. Ulceration having once been set up, the healing process is prevented by the presence of this cuticle, together with the pressure of the edge of the nail, and the soft parts covering it in. Fungous granulations, as a consequence, frequently form, and copious discharge takes place, the affection being attended with severe pain.

TREATMENT.—The disease being the result of pressure applied from without in the shape of tight boots, or from within in the form of indurated cuticle beneath the nail, the surgeon's main object in the treatment is to take away the exciting cause; and, when the collection of cuticle exists, by the careful introduction of a probe beneath the nail, to procure the evulsion of the foreign body. In early examples of the disease this treatment is often sufficient. When external pressure has been the cause, and ulceration exists, the soft parts may be carefully pressed away from the sharp edge of the nail by the careful introduction beneath the overhanging integument of a small roll of lint, which should be well pressed down to the bottom of the sore, and fixed in position by means of strapping, applied so as to draw the soft parts away from the nail. This treatment, by removing all pressure from the sore, as a rule, being successful. When the fungous granulations are excessive, and the discharge profuse, the free use of alum, oxide of zinc, lunar caustic, the solution of the perchloride of iron, or more particularly the powdered nitrate of lead before the application of the lint, is of great value. After one or two applications of the lint, in the manner previously described, the soft parts will have been so pressed to one side as to expose the edge of the nail with the surface of the sore; and, under these circumstances, the lint, or a piece of thin sheet lead or tinfoil, may be carefully introduced beneath the edge of the nail, and the dressings renewed. Under this treatment a rapid cure readily ensues, and if no external pressure be re-applied, and the nail is allowed to grow up in its normal square form, there will be no recurrence. In severe cases, where the soft parts so overhang the nail as to be unaffected by the means here suggested, or, in which the nail perforates the soft parts (Fig. 52), the

FIG. 52.



best course is to excise the overhanging integument by means of a scalpel, for by this method the ulcer is exposed, and all external pressure at once removed, the sore, as it heals, having a tendency to contract, and thus considerably to diminish the chance of a repetition of the affection.

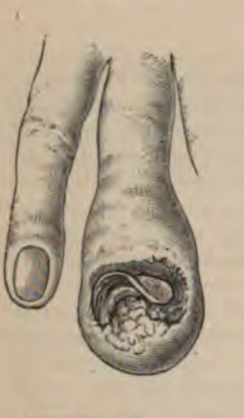
When the ulcer has spread far under the nail, it may be expedient to remove a portion of the latter to allow of cicatrization; though, in a general way, to remove half the nail, to take away a V piece from its centre, to scrape or notch it, are only temporary remedies. They may succeed for a time, and allow the sore to heal, but it is certain to recur in all severity, as soon as nature has restored the parts which the surgeon has injured.

To cut the corner of the nail, under the idea that it is the offending body, is a futile proceeding; it may for the moment appear to be of service, but, in the end, it is injurious; indeed, the nail should be left square, as nature made it, and care should be taken to see that the soft parts are in no way pressed over its edge.

ONYCHIA MALIGNA.

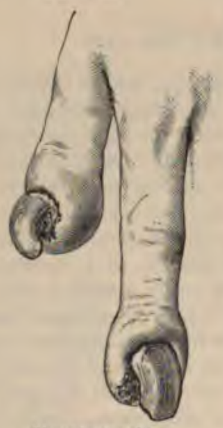
This is a disease of the nail matrix, and a far more severe and obstinate affection than the last. It is found most commonly in unhealthy children, and, as a rule, is started by some local injury, such as a squeeze. It commences as a swelling of the end of the toe or finger, with the other external signs of inflammation—redness, heat, and pain. These symptoms are soon followed by the exudation from beneath the nail of a serous fluid, which is often fetid; the nail itself loosens, sometimes falls off, or either flattens out or curls up at its edges (Fig. 53). When this occurs a foul ulcer is visible beneath. In extreme cases the affected parts assume a flattened bulbous form, and look as incurable as any local affection can well appear, and, in rare instances, the disease involves the last phalangeal joint or bone. It is never found in other than feeble and cachectic children. The worst case I have seen of this nature occurred in a child, æt. 10, in whom the fingers and thumbs of both hands were involved, and had existed for years.

FIG. 53.



Acute onychia.

FIG. 54.



Chronic onychia.

TREATMENT.—In favorable and not extreme examples of this affection tonics internally and water-dressing externally suffice to bring about a cure; while in others more active local treatment is called for, such as the application of some mercurial lotion, as black-wash, or Abernethy's lotion (formed of the liquor potassæ arsenitis ʒij to ℥j of water) or the red oxide of mercury ointment. In the case to which I have already alluded all this treatment failed, even after the evulsion of the nails—a plan of treatment that should always be adopted in obstinate cases. The cure was at last effected by making a clean shave of the dorsal aspect of the extreme phalanx, taking away nail and soft parts. This course was resorted to only after the disease had existed for five or six years, and had resisted every form of treatment, even to the repeated evulsion of the nails; the pain being agonizing and demanding surgical interference. Fig. 54 was taken from one of the fingers of the patient. Professor Vanzetti, of Padua, strongly advocates the application of the powdered nitrate of lead to the ulcer, and my own experience of its value justifies me in strongly recommending it. Constitutional treatment with tonic regimen is always necessary.

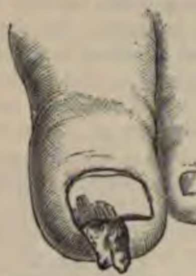
The disease may at times have a syphilitic origin, when it will be wise to adopt specific treatment.

OTHER DISEASES OF THE NAILS.

Under the influence of some acute diseases, the nails cease to grow, and the arrest becomes manifest, as convalescence advances, by a transverse groove in the nail, while the width of the groove denotes the duration of the arrested growth. As a result of hereditary syphilis Mr. Hutchinson has shown, that the nails may become completely ridged, while even in acquired syphilis, Hutchinson, Wilks, and Fagge have fairly proved that the nails may become narrow, thick, ill-formed bodies, or concave, rough, and black.

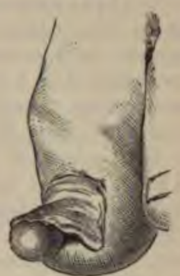
Psoriasis affects the nails somewhat in the same way, the nail thickening and splitting vertically, and in *favus*, Fagge has shown that the part may become thickened and of a yellow color from the interstitial deposit of the parasitic disease. Wilks, in the 'Lancet' for 1868, and Fagge, in 'Guy's Hosp. Rep.,' 1869–70, have written fully on these points. At times the nails become soft, and, in feeble subjects, very convex. This condition is said to be common in phthisical subjects, but in surgical disease I have often observed the same condition appear during illness, and disappear as strength returned. I regard it only as an evidence of feeble power.

FIG. 55.



Horny growth from beneath nail.

FIG. 56.



Ungual exostosis.

Horny growths occasionally spring up beneath the nail, as seen in Fig. 55, and **ungual exostosis** very frequently appears—which is, a bony outgrowth from the extreme phalanx of the great or other toe, as seen in Fig. 56. Both require excision.

ELEPHANTIASIS.

This term has been applied to two very different diseases, the *Elephantiasis Græcorum, or true leprosy*, and the *Elephantiasis Arabum, or Cochin or Barbadoes leg*. The former is probably constitutional, and appears as a tubercular affection of the skin, more especially of the face, attended with some loss of sensation. It is usually ushered in with slight febrile disturbance and local œdema. As it advances, the skin thickens and the tubercles multiply; the disease spreads, and involves the tongue, mouth, nose, eyes, and even larynx and lungs. In extreme cases ulceration and disease of the bones exist; the subjects of the affection dying from exhaustion, if not from suffocation. It is, happily, rare in this country, although it does occur occasionally; it is, however, common in Norway, in the Mediterranean, and in the Indies. Dr. Webster, in the 'Med.-Chir. Trans.' for 1854, and Mr. Day, in the 'Madras Quart. Journal' for 1860, give valuable information on the subject, and Dr. Carter, in the 'Trans. Med. and Phys. Society of Bombay,' vol. viii, new series, enters fully into its pathology.

The disease has been regarded as incurable, although, since the introduction of the Gurjun or wood oil by Dr. Dougall, of the Indian Medical Service, in 1873, better results of its treatment may be expected. The oil is used as an external application, made into an emulsion with lime water, in the proportion of one part to three, and should be well rubbed in twice a day for two hours at a time. It has also to be taken internally in two-drachm doses mixed with the same quantity of lime water twice a day. With this treatment the tubercles are said to soften down; and in their place watery blebs form, which burst and discharge a clear serous fluid, and then the induration gradually subsides. The oil taken internally is a diuretic and purgative.

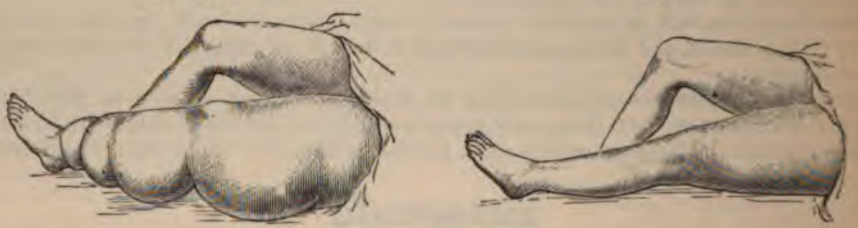
To the surgeon the second form of elephantiasis, or the *Elephantiasis Arabum*, is of the greatest interest. It is possibly a local affection, and quite distinct from the true leprosy. It appears generally in one or other of the lower extremities, or in the male or female genital organs; showing itself as a general infiltration into the skin and subcutaneous tissued of an organizable material, whereby the integument becomes hypertrophied and greatly thickened. In advanced disease the skin falls into great folds, and, between these, fissures form, which subsequently pass into oozing ulcers. At times the foot and leg become the seat of extensive ulceration, which rarely cicatrizes.

It generally begins with some febrile attack, and the affected part becomes the seat of an erythematous redness and swelling, which subsides, again to recur, and each attack leaves some extra thickening behind it. I have observed this very clearly in one case, and have no doubt that the erythema had some distinct relation to the disease.

Dr. Wise, of Calcutta, in 1835, looked upon the disease as one of the venous system, and inflammatory. Dr. Carnochan, of New York, believes it to be associated with an enlargement of the arterial trunks of the part, and upon this theory based his practice of tying the main artery of the limb, thereby starving the disease. Mr. Day, in the paper already alluded to, regards it as consecutive to malarious fever, while Mr. Dalton ('Lancet,' 1846) looks upon it as a constitutional disease, like the leprosy. From the many cases I have seen I do not believe in the theory of its being due to disease of the venous system, because pathological evidence is wanting to support the view, yet I am disposed to regard it as a true hypertrophy, and in this I am supported by the clinical fact that in some cases, though not in all, where the main artery of the limb is ligatured, and the vascular supply to the disease cut off, a recovery takes place.

Carnochan, of New York, was the first surgeon to perform this operation (in January, 1851), and the success he met with, as published in a memoir on the subject in 1858, induced me to follow his example in 1865. My case in all its details was published in the 'Med.-Chir. Trans.,' 1866, and the benefit of the operation was most striking. It occurred in the case of a Welsh girl, æt. 25; the disease had been of two years' standing, and was spreading. The thigh of the affected limb (Fig. 57) measured twenty-seven inches round, and the leg nearly twenty-three, the affected leg being nine inches in circumference larger than the sound one, and the thigh seven. Five weeks after the ligature of the external iliac artery the calf of the affected limb measured seven inches less than it did at the time of operation, and when she left the hospital the limb appeared as in Fig. 58. The rapid disappearance of the thickened tissue was very remarkable. Since the operation, the girl has gone on well, is companion to a lady, and can now walk ten or twelve miles. The limb becomes slightly œdematous only on over-exertion.

Fig. 57. Fig. 58.



Case of elephantiasis Arabum before and after the application of a ligature to the femoral artery.

I have performed the same operation three times since, but not with similar success. I ligatured the femoral artery of a man who had the whole limb involved, the thigh being only slightly so, and, for a time everything promised to be as successful as in the case previously recorded; but an attack of erythema came on, followed by renewed swelling of the extremity, which never disappeared. In this case the size of the superficial femoral artery was extraordinary, the loop of the silk ligature when it came away being capable of admitting a No. 12 catheter. The vessel seemed to be nearly the diameter of my finger and was very thick. In a more recent case, however, gangrene of the foot, followed by death, took place.

When this operation is performed the vessel should be ligatured well above the disease. I may add that Butcher in 1863 and Alcock in 1866 had successful cases; though Fayrer, late of Calcutta, and Buchanan, of Glasgow, have not met with successful results.

When surgical interference of this kind is not applicable, elevation of the affected limb or pressure should be employed. In severe cases amputation may be called for.

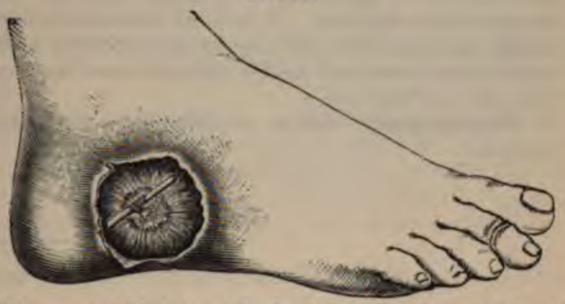
ON PARASITES.

Guinea-worm.—The *Dracunculus* or *Filaria medinensis* is one of the most troublesome parasites known in Africa, Asia, India, and tropical America. In Europe it is only occasionally met with in those who have visited the above districts.

The mature worm varies in length from two to six feet. It is cylindrical in form, white in color, has a smooth surface, is tough and elastic; its mouth appearing as a circular orifice; and has no anus. How it enters the body is unknown, although it is evident that it does so from without, and probably through the skin of some part that has been in contact with water, inasmuch as it is more common in the feet than in other parts of the body, although the Madras water-carriers are said to have them in the back. At any rate, the worm gets into the subcutaneous areolar tissue, where it remains. Busk tells us that it does so usually for about twelve months, although it may be eighteen; when mature and the time has come for the discharge of the embryos with which it is filled, it makes its presence known by boring the skin, protruding its head under the cuticle, raising a bleb, and coming out bodily, discharging its young filariæ externally.

The first manifestation of the disease is usually a circular bleb, as represented in Fig. 59, although it often happens that pain and stiffness of the affected part have been complained of for some time previously. The bleb contains sero-purulent fluid, and the surgeon, in order to find the worm, should cut the raised cuticle off. "There will then be seen protruding from a little hole in the centre of the denuded cutis one or more inches of the worm of the size and color of vermicelli or of a wax match. The surgeon now makes a small quill-like roll of adhesive plaster, rolls the worm around it, and gently draws as much as will come without the risk of breaking; and this is repeated day after day, till at last the tail, which ends in a small hook, comes wriggling out, and the case is at an end." (Druitt, 'Med. Times and Gaz.,' Jan. 3, 1874.) Under these circumstances a rapid cure takes place. Should the worm break, a subcutaneous abscess is almost sure to form higher up; and when this is opened a loop of the worm can most likely be got out on a probe, and so be extracted as before.

FIG. 59.



Guinea-worm bleb just cut off. Dr Druitt, 'Med. Times and Gaz.,' Jan. 3, 1874.

At times no bleb forms, but merely a subcutaneous abscess. In exceptional cases more than one worm may exist. Druitt quotes a case in which nineteen had been extracted.

Considerable constitutional disturbance often attends these local changes.

Chigoe, Chigger, or **Gigger,** or **Sand-flea.**—This is found in the West Indies and in South America, but the impregnated female only infects man. It makes its way beneath the nails or between the toes by means of its long proboscis, and, having gained an entrance, rapidly increases to a white globular vesicle the size of a pea. Some local irritation attends its presence. To prevent trouble, the insect should be carefully turned out of its bed by dilating the orifice through which it entered with a needle, care being observed not to rupture the globular vesicle which contains the ova, for if these escape into the cellular tissue the accident is often followed by tedious suppuration and ulceration.

The echinococcus or hydatid, the larva of the tænia echinococcus, is a common entozoon in the human subject, and it may exist as a microscopical object, or as a cyst of many inches in diameter. It has highly elastic laminated walls, lined with a granular layer, and it is usually inclosed in the parts of the body infected by it in a distinct capsule, formed by exudation into and the consolidation of the surrounding tissue. It contains a clear, watery, non-albuminous fluid, in which at times float some tænia heads or scolices, the so-called echinococci, or in which are found the hooklets which surround the head.

These hydatids are met with in any part of the cellular tissue of the body—in the lungs, liver, abdominal cavity, pelvis, and even in the bones—a specimen exists at Guy's in which the spinal column was so affected. I have seen them turned out of the breast, tongue, thyroid gland, pelvis, vagina, uterus, thorax, and bladder, and have removed a cyst containing them from the muscles of the neck, axilla, and thigh, as well as having treated many also in the liver.

At times an acephalocyst contains many secondary cysts. I removed a basinful from one occupying the pelvis, and they were of all sizes ('Path. Soc. Trans.,' vol. xvii). Hydatid tumors are to be recognized by negative symptoms; they appear as tense, globu-ar, elastic swellings in a part, and give rise only to such symptoms as are to be explained echanically by their presence; when dead they give rise to suppuration.

TREATMENT.—This must vary with the position, size, and growth of the hydatid mors. When the parasite occupies some position in the body outside one of its great vities, and can be turned out of its bed by means of a free cut into its capsule, no better eatment is required. When it occupies one of the abdominal viscera or one of the serous cavities, it should be left alone, unless from its size it interferes with important functions or threatens life, but this point will be discussed in another page.

The cysticercus cellulosæ, the cystic scolex of the common tapeworm, is found in man, and is said to be the common parasite of the "measly pig." It has a quadrangular head, short neck, and cylindrical vesicular body; the head being surrounded with characteristic hooklets. It is found more particularly in the muscles and intermuscular tissue, and may affect the viscera as the former hydatid. It is known to occur in the eye, brain, heart, &c., and can be treated, when interference is called for, by an incision into the part and removal.

Trichiniasis will be considered in the chapter devoted to the affections of the muscles.

SURGERY OF THE LYMPHATIC SYSTEM.

CHAPTER V.

INFLAMMATION OF THE LYPHATICS AND THEIR GLANDS.

THE absorbent glands with their ducts, are liable to inflammation, "*adenitis*" or "*angeioleucitis*," and this action is probably the result of the absorption of some septic material. It is almost always associated with a wound, punctured or open, inflamed, suppurating, healing, or scabbing; with some point of irritation or suppuration, even a papule or pustule; with some centre from which morbific elements may be taken up. In what is called a simple wound the inflammation of the absorbents may be acute, but in poisoned it is violent and diffused. The inflammation always follows the course of the absorbents, leading from the centre of absorption towards the glands, that is, towards the body, and it never spreads backwards. When it has reached the glands, the diseased action ceases to spread; that is, it expends its force upon the group of glands in which the absorbents naturally end and does not extend through another series of absorbents to a second group. The morbific material is arrested in the glands, at least, such is the usual course of the affection. When pyæmia follows or complicates the case, it may be open to question, whether the poisonous fluid circulating in the lymphatics has not been allowed to pass into the blood through its usual channels, that is, through the inflamed glands onwards, but it is at least as probable, that the same septic material that poisoned the lymphatics and set up inflammation in the tubes and glands, was taken directly into the blood through the venous channels, thus giving rise to blood poisoning.

Absorbent inflammation usually manifests its presence in a definite way. Pain in some of the glands and tenderness are generally early symptoms, and, with these, or soon following them, will be seen a band of redness, varying in diameter, leading from the wound or infecting centre towards the gland. This red line may be continuous or interrupted; it may be a thin streak or a broad stripe of redness, and in some instances so radiate into the surrounding tissues as to simulate erysipelas. The whole line of redness is very painful, and with these local symptoms there will be also some febrile disturbance, very probably the attack will be ushered in with a rigor. It should be noted that the red lines follow the course of the absorbents and not of the veins.

Under favorable circumstances and treatment these symptoms may subside, and the red line, with the swelling of the glands and cellular tissue around the inflamed parts, together with the constitutional symptoms, will disappear.

In less favorable examples suppuration may take place, either as a local or diffused suppuration of the affected glands and surrounding cellular tissue; as a local abscess in the course of the lymphatics, or as a series of local abscesses. In extreme cases the suppuration may partake of a diffused character, such as that already described as taking place in phlegmonous erysipelas.

With these local changes the constitutional symptoms will assume different features; the febrile disturbance probably being great, but marked by depression; rigors may repeat themselves at regular intervals, these generally indicating some suppurative process. When typhoid symptoms appear with rigors and sweating, the case has clearly become one of blood poisoning or septicæmia.

There are thus three different classes of cases:

The simple, terminating in resolution; the more severe, ending in local glandular or lymphatic suppuration; and the complicated, marked by diffused inflammation and suppuration with general blood poisoning.

In the simple form, the poisonous element is probably of a diluted or but slightly irritating nature, and is generally some altered secretion of a simple wound due to external irritation. In the more complicated or severe forms, the poisonous element is of a more active kind, and has been either introduced from without in the form of a distinct animal poison, such as is derived from a dissection wound, or the bite of an animal; or is generated from within, as seen in puerperal cases.

Inflammation of the absorbents, erysipelas, phlegmonous or otherwise, and septicæmia, are all closely connected.

The effects of inflammation of the absorbents, however, are not constant or alike in all cases. In some the glandular enlargement alone is to be recognized, with more or less extensive suppuration of the glands and their surrounding connective tissue, without any external evidence of inflammation of the lymphatics leading to the glands. In others the red line of inflamed absorbents will be visible without glandular complication, or little more than a slight induration of the gland. At times there will be suppuration only along the track of the lymphatics but none in the glands, this suppuration taking the form of local abscesses. I have seen in a case of absorbent inflammation of the forearm and arm, four distinct abscesses in the line of inflammation, with only axillary glandular tenderness.

Occasionally the lymphatics appear as a hard cord beneath the skin. In a case I had under my care some years ago this cord remained hard and contracted for many weeks after all signs of inflammatory action had ceased. It occurred in a gentleman who was in the habit at night of going through some simple muscular exercises, and in doing this, the cord in the arm snapped on the inner side of the biceps. I saw him a few minutes after the accident, and felt the two ends of it, which were apart for about an inch. Next morning the thin skin covering the anterior surface of the forearm was elevated, loose and baggy, from the effusion of fluid beneath it. There were no signs of inflammation or pain beyond local tenderness at the point of rupture of the lymphatic cord. In four or five days the fluid was reabsorbed, and convalescence restored, the hard cord gradually disappearing, and all traces of its separation becoming lost. I looked upon the effused fluid as lymph that had been poured out by the divided lymph tube, and which had been taken up again. I have not seen a similar accident since.

This absorbent inflammation is most common in the extremities, though it may occur anywhere. There seems no doubt that a large number of the cases of glandular abscesses are of this nature. Pelvic abscesses in women are known to be of this kind, because pus has been found in the absorbents of the part.

Glandular suppuration in the neck is, from its position, a dangerous affection, the connective tissue of the parts being so loose, and the fascia covering them so firm, that burrowing suppuration often takes place. These deep-seated suppurations should be opened early, and as soon as any local evidence of pus exists; and in this way, viz., by cutting through the fascia with a lancet, and thrusting a director or forceps into the deep connective tissue. I have opened an abscess at the base of the tongue in this manner, from beneath the jaw, with an excellent result. The swelling affected deglutition and respiration, and threatened life.

TREATMENT.—When any indications of absorbent inflammation show themselves, the wound or sore should be well cleansed, the scab removed, and any collection of pus let out. The affected limb should be raised, the foot, when involved, brought higher than the hip, the hand or elbow than the shoulder; and warm poppy fomentations should be applied along the whole course of the lymphatics up to the group of glands in which they terminate. Some surgeons, particularly the French, advise that the inflamed line should be pencilled with caustic, and dry warmth applied, such as cotton wool; but I prefer the practice already indicated, as it seems to give more comfort. Leeching is rarely, if ever, required.

As soon as suppuration appears, the abscess must be opened, whether this follows directly upon the inflammation or subsequently; inasmuch as suppuration at times is very insidious. At the very earliest period of the inflammation, when the tongue is foul, an emetic certainly seems to have some influence in checking its progress. It is a simple and valuable remedy. A good saline purge is also beneficial.

Sedatives should be given to allay pain, such as small doses of morphia, three times a day, with a double dose at night, to induce sleep. When suppuration has taken place, tonics may be administered, and iron is the best.

In chronic cases, where induration in the track of the ducts remains, mercurial ointments and friction are sometimes valuable.

Glands are very apt to inflame after fevers or the exanthemata; and particularly those in the neck. These affections often give rise to much local distress. In patients who are not extremely feeble these enlargements, as a rule, subside by themselves under careful management. In exceptional cases they suppurate.

Local warmth applied by means of cotton wool, tonics and nutritious food, are the best remedies; but when suppuration threatens, warm fomentations are more grateful to the patient. Abscesses should be opened early. Before opening, however, it is well to try what drawing-off the pus by means of the "aspirator" may accomplish, repeating the operation as the pus re-collects. In some instances a cure may be effected by these means, and thus a scar is prevented. Should it fail, an incision ought to be made.

The local application of iodine under these circumstances, although a common remedy, does not appear to be of much value.

Chronic granular enlargement is a very common affection. When found in the so-called strumous subject the disease is regarded as a strumous one of the glands, yet it is very difficult to lay down any definite cause for its appearance. It is found in the strumous and feeble child, it is true, as a chronic and slightly painful enlargement of a gland or glands, more particularly those beneath the jaw and about the neck, and comes on sometimes after exposure to cold, some slight illness, local irritation, or without any definite cause, often subsiding spontaneously on the removal of the cause or on the improvement of the general health. There always exists, probably, some local cause of irritation. At times these glands suppurate and leave ugly sores, the cellular tissue around the gland becoming destroyed and the skin consequently undermined. The pus from these glandular enlargements is sometimes ill formed and curdy; and when it attends the breaking down of some old disease it may contain chalky deposit, this being some degenerated or dried-up tuberculous or other matter.

Hodgkin's disease of the glands.—There is, however, another chronic enlargement of the glands that appears to differ in all ways from the local enlargements to which attention has just been drawn. It was first described by Dr. Hodgkin in the 'Med.-Chir. Trans.,' vol. xvii, and may be called Hodgkin's disease of the glands, or, for the sake of distinction, glandular tumors. He observed it first in the mesenteric glands, though any or all may be affected. In it the glands become very much enlarged, even to the size of an egg, and apparently more numerous; they present a smooth external appearance, and have a soft semi-fluctuating elastic feel. On section, the surface of the gland presents a smooth, bloodless, semi-transparent, loose, succulent structure; microscopically it is made up of glandular tissue and abundance of fibro-nucleated tissue; it is of a tough leathery consistence, and exudes a clear serous fluid. The tumors are always free, each being separable from the others.

To the surgeon, the disease, at times, appears as a local movable glandular tumor of a slow painless growth, which medicine has no power of influencing; it has the local clinical appearance of a benign fibro-cellular tumor, and has often been excised as such.

In other instances the tumors are multiple, three, four, or more existing in one locality, chiefly in the neck. In exceptional instances the tumors are more numerous. I have seen a case in which, on one side of the neck, the subcutaneous tissue seemed filled with loose glandular tumors, readily movable one upon the other, as if simply confined by skin, in the same way as the adenoid tumors of the breast are occasionally met with. In still rarer examples the whole glandular system seems to be affected, every group of glands not only being apparently enlarged in size, but also increased in number.

This disease is often associated with an enlarged spleen, and appears pathologically to be allied to that blood disease now known as leucocythæmia, notwithstanding that in many instances the white corpuscles are not in excess.

On one occasion I had an opportunity of watching the gradual development of this affection. It began in the cervical glands, and gradually involved the whole glandular system, the boy, at the age of fifteen, dying with an enormous spleen and glandular tumors in every region. His blood was made up almst entirely of white blood-corpuscles, death resulting from exhaustion.

Treatment.—For the ordinary or strumous enlargement of the glands in children there is no drug equal to cod-liver oil, the syrup of the phosphate or of the iodide of iron, or, the tincture of quinine being capital additional remedies.

I have not much faith in the local application of iodine in the form of the tincture; as after the second application the skin ceases to be an absorbing surface, and the iodine becomes, therefore, a mere irritant. For some years I have been accustomed to order the solid iodine to be placed in a perforated box, and on a shelf in the sitting and bedrooms; the iodine in this way evaporating gradually and iodizing the air. In all glandular, as in thyroid enlargements, this mode of employing the drug seems to be of considerable value.

The iodide of ammonium as an ointment is a useful application when rubbed in, the iodide by this process becoming absorbed.

Good food and fresh air are also essential points in the treatment of these cases.

In Hodgkin's glandular tumors iron in full doses as well as cod-liver oil seem to be the best remedies; that is, patients who can take them appear to improve in their general health, while the disease does not progress so rapidly under their use as without it; but, upon the ultimate issue, no remedy seems to have any decided influence, and it always ends fatally in two or three years. When isolated glandular tumors exist they may be dealt with as local tumors and removed. This practice should, however, only be carried out when the tumor is in the way and interferes with life's value or usefulness. Under other circumstances they had better be left alone.

In all glandular enlargements, however, with the exception of Hodgkin's disease, the local cause of irritation should be looked into, with a view to its being removed; because, practically, it is well to regard all glandular enlargements as due to a chronic source of irritation, in the same way as acute adenitis is known to be a result of inflammation of the lymphatics.

Lymphatics may be wounded by accident or by design, and no bad result ensue. At times, however, a fistulous opening that discharges lymph may remain. The same consequence may be the result of disease. Dr. H. V. Carter, of Bombay, has recorded three such cases in the 'Med.-Chir. Trans.,' vol. xlv, and Dr. Day another in the 'Clinical Soc. Trans.,' vol. ii. Through the kindness of the latter I had an opportunity of seeing his case. It was reported on by a committee of the society, and they confirmed the view taken of it. It was one of hypertrophy of one lower extremity of a boy, with the occasional discharge of chyle from vesicles, which were formed on varicose lymphatics. The hypertrophy had clearly an intimate connection with the distended state of the lymphatics of the limb.

Disease of the glands, as connected with cancer and syphilis, is referred to in the chapters devoted to those subjects.

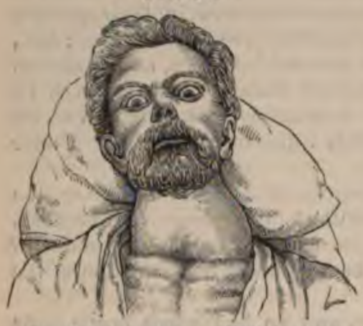
DISEASES OF THE THYROID GLAND.

The thyroid is a ductless, yet highly vascular, gland, has as large a vascular supply as any gland in the body, and it is supposed to have some connection with blood formation. It is also freely supplied with lymphatics. It is also a lobulated encapsuled gland, with a cellular structure, the cells containing a glairy fluid. When it is simply enlarged it is said to be hypertrophied, or the seat of *goitre* or *bronchocele* (*simple adenoid enlargement*), and it is well known that these goitres attain a large size. Sometimes they are apparently composed of simple increase of tissue, the enlarged gland having much the same appearance on section as the small and healthy one; at other times the structure of the tumor is coarser, more cellular, or cystic (*cystic enlargement*), the cysts occasionally assuming large dimensions; while in a third the gland is more solid and fibrous, or more or less mixed with cysts (*fibrous or fibro-cystic disease*). The thyroid gland may inflame, as well as suppurate, and may be the seat of distinct adenoid tumors or of cancer. Hydatid cysts have also been enucleated from its body (*vide* Prep., Guy's Hosp. Mus., 1711[60]).

Goitre, or Derbyshire neck, as it is generally known in this country, is very common. In its most usual form it appears as a simple hypertrophy of the thyroid gland, giving rise to symptoms which are attributable to the size of the tumor; when of moderate dimensions it may not be inconvenient, when even large it may be so, and still produce no symptoms worthy of special notice. At times, small tumors cause symptoms, such as dyspnœa, or the cough as of a broken-winded horse on exertion, and even difficulty in breathing on the slightest cause. At other times they mechanically press upon the large vessels and respiratory tract, producing headache and a feeling of fulness of the head on stooping or coughing, with evident respiratory obstruction, and even difficulty in deglutition. These symptoms may also appear for a time and then disappear, leaving the patient comfortable in all respects during the intervals. In other cases, goitres which appear to be of the simple kind begin to pulsate under excitement, or other unknown cause, and are attended with some protrusion of the eyeballs. These symptoms disappear with rest and time, and the case subsequently reassumes the clinical features of a simple goitre.

Such cases as these stand as a kind of link between the simple and that known as the *exophthalmic* goitre, Graves, or Basedow's disease, and yet, between these two affections there must be some wide difference, for the simple goitre appears to be a local affection, whereas the exophthalmic form is probably part of a more general disease marked by the enlargement of the thyroid body, often by prominence of the eyeballs, always by palpitation of the heart, a peculiar thrill in the bloodvessels, and a general want of muscular and brain power (Fig. 60). Modern notions tend to indicate that this form of goitre is a neurosis of the cervical sympathetic. "The numerous functional disorders which occur in Graves's disease are either due to temporary congestion of the sympathetic nerve, or a permanent structural alteration of the ganglionic nervous system." (Trousseau's 'Clin. Med.') This view, however, of the affection is not yet proved, and the whole subject requires investigation.

FIG. 60.



Exophthalmic goitre. (Wilks's case.)

TREATMENT.—Simple goitres are to be treated on ordinary principles, viz., by attention to the general health, the inhalation of fresh air, and by tonic medicines. Filtered or distilled water should always be taken, more particularly in districts where chalk, lime, and magnesia abound. In Derbyshire and the Tyrol districts it is generally believed that it is from the water that the disease is produced. Iodine has always been held in high repute in this affection, originally as burnt sponge, and recently in the form of the iodide of potassium, and in four or five-grain doses, given with bark or quinine, this drug is of use. For some years, however, I have given tonics alone by the mouth, and have ordered the air in the room to be kept iodized by means of solid iodine, put into a box with a perforated lid, as already described; the metal thus evaporates steadily into the room where the patient sits and sleeps, and in this way it becomes absorbed. Under its influence I have often been surprised to find how rapidly goitres disappear. With this treatment I at times rub in an ointment of the iodide of ammonium, a drachm to an ounce. To paint a goitre with the tincture of iodine is useless, as one application renders the skin hard and incapable of absorption. Dr. R. Stoerk, of Vienna (1874), injects alcohol into the soft parenchymatous and cystic varieties; one or two drachms being introduced by means of a Pravaz syringe, turning the goitre hard by causing coagulation of its colloid contents. The injections should be repeated at intervals of several days, in different parts of the tumor. He, however, advises that a few drops of iodine should be added to the alcohol to prevent fermentation taking place. Dr. Lücke, of Berne, is in the habit of treating hard goitres by injecting strong tincture of iodine into the tumor, one or more punctures being made at a time, according to the size of the tumor, and he reports with good success. ('Lancet,' 1859.) Dr. Mouat, of Bengal, spoke ('In. Annals of Med. Science,' 1857) very highly in favor of the use of biniodide of mercury in combination with the rays of the sun, for the cure of goitre. He used the mercury as an ointment of the strength of three drachms to a pound of lard. It was rubbed in for ten minutes, an hour after sunrise, and the patient had afterwards to sit with his goitre held well up to the sun, as long as he could endure it. After this a fresh layer of ointment was to be applied with a careful and tender hand, the patient sent home, and the ointment left to be absorbed. In ordinary cases this treatment was said to have been sufficient to effect a cure, and that only in exceptional cases was a fresh application necessary. He gives his cases of recovery by thousands. It is possible that in this country the treatment has failed for want of the rays of the sun. I have tried it without the slightest beneficial result.

In Graves's disease iodine appears to be not only useless but injurious. Tonics, more particularly iron, are apparently the most applicable.

In exceptional cases a goitre may so increase and press upon the larynx and surrounding parts as to threaten life, and may even cause death by a gradual process of suffocation, but more commonly by exciting some sudden laryngeal spasm. In 1869 I treated such a case, sent to me by Mr. Holman, of East Hoathly, in which a large thyroid gland was causing chronic suffocation by its mechanical pressure, and it ultimately produced immediate death by exciting some laryngeal spasm. Dr. Herbert Davies has recorded a similar case ('Path. Soc. Trans.,' 1849), and in the Museums of St. George's and Bartholomew's Hospitals preparations exist with similar histories.

In some cases the treatment by setons has been of value, suppuration of the thyroid having been followed by a rapid subsidence of the hypertrophied or fibrous structure of the gland. Mr. Hey, of Leeds, adopted this practice with much success. In other examples of goitre the question of operative interference may have to be entertained, and will be considered in another page.

Cystic Bronchocele.—*Cysts* are often met with in this gland, and occasionally they assume large dimensions. They appear as more or less globular, tense, fluctuating tumors, moving up and down with the larynx, as all thyroid tumors do. They may contain only the glairy fluid of the gland, or a more serous or sanguineous fluid, or old grumous blood. Occasionally on being punctured they will go on bleeding even to the death of the patient. Such cysts appear either in one or other lobe or in the isthmus. In 1872 I treated, with Dr. Hess, a case of blood-cyst of the isthmus in a girl, and drew off about half an ounce of a thick, grumous, coffee-looking fluid. In 1863 I tapped a cyst, the size of a cocoa-nut, in the right lobe of the thyroid of a woman æt. 26, which bled profusely, and the hemorrhage was only arrested by closing the wound. The cyst filled up at once nearly to its former size, but subsequently gradually contracted, and after five or six years scarcely any remains of it could be found. Simply tapping a serous cyst may cure it. When it fails, the cyst may be injected with a solution of iodine varying in strength from five to ten minims of the compound tincture to a drachm of water or simple alcohol. When these fail, a seton has been recommended, which is, however, a dangerous practice, and should only be adopted when simpler means are unavailing and further interference is requisite. In cysts of the isthmus, more particularly blood-cysts, an incision into the cavity is a good and successful operation. Should a cyst after tapping suppurate, it must be dealt with as an abscess, and freely opened as soon as the existence of pus can be made out, for the thyroid is in a dangerous position for suppuration to occur. I have successfully treated one case of suppurating thyroid cyst, after tapping by incision, but the cases in which this treatment is called for are rare.

Dr. M. Mackenzie has ('Lancet,' May, 1872) advocated the practice of converting the cystic disease of the thyroid into a chronic abscess by the following means:—"First empty the cyst. When practicable, it is well to make the puncture as near as possible to the median line, and to select the most dependent portion of the tumor for the introduction of the instrument. As soon as the trocar is felt to pierce the cyst-wall it should be withdrawn, and the canula passed further in by means of a blunt-pointed key. The fluid having been withdrawn through the canula, a solution of the perchloride of iron (two drachms of the salt to an ounce of water) is injected through the canula by means of a syringe. The plug is re-inserted, and the canula secured in position by a strip of plaster. The injection of iron is repeated at intervals of two or three days, until suppuration is established. When this point is reached the tube is withdrawn, poultices are applied, and the case treated as a chronic abscess. Where the tumor consists of more than one cyst, it may be necessary to make a second or a third puncture; but it frequently happens that other cysts can be opened through the cyst originally punctured." Some cysts become calcareous, and should be treated by excision. This practice is only, however, to be entertained when the cyst causes symptoms which threaten life. In Guy's Hosp. Museum there is a preparation of a calcareous cyst with an intra-cystic growth.

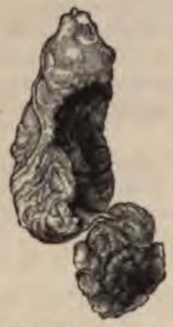
Acute inflammation of the thyroid gland is doubtless a rare affection. I have never seen such a case. Holmes Coote records one in 'Holmes's System.' Suppuration of a cyst in the gland after surgical interference is more common.

Acute hypertrophy may appear and produce dangerous, if not fatal symptoms. Dr. Risdon Bennett, in his interesting 'Lumleian Lectures for 1871,' has recorded such an instance, which I had the advantage of seeing, in consultation with him and Mr. Jackson, of Highbury. It was in a young man, æt. 19, who, three months before, became the subject of paroxysmal attacks of asthmatic dyspnœa, associated at times with a wheezing or whistling respiration, and some general enlargement of the base of the neck. Three days before his death this difficulty became extreme, the paroxysms became more frequent and severe, and, on the day of his death, a severe paroxysm took place, which passed on to a forced and heaving respiration, beyond anything I had ever before witnessed, and speedy death resulted. I performed tracheotomy upon the patient, with the slender hope that some light might be thrown upon the nature of the case to guide us in its treatment, if not to give relief, but in doing so, what was probable before became evident then, viz.—that the obstruction was below. I had no perforated instrument with me long enough to force beyond the point of obstruction except a female catheter, which struck against some solid body that prevented its progress. After death the thyroid body was found to be much enlarged, and mainly below the sternum and along the sides of the trachea. The trachea below my opening was flattened laterally to within half an inch of the bifurcation; and was also twisted to the left, being surrounded by the greatly enlarged and firm lateral lobe of the thyroid. The structure of this enlarged gland was clearly that of hypertrophy, not of cystic or other apparent disease. As an example of acute rapid hypertrophy of the thyroid, the case, says Dr. Bennett, "points to the propriety of regarding any acute enlargement of this gland in young people with more anxiety than we are perhaps accustomed to do," particularly, it should be added, when the lobes of the gland pass down behind the sternum.

Thyroidal tumors, doubtless, exist, although they are not common; these may be *adenoid* and innocent, or *cancerous* growths.

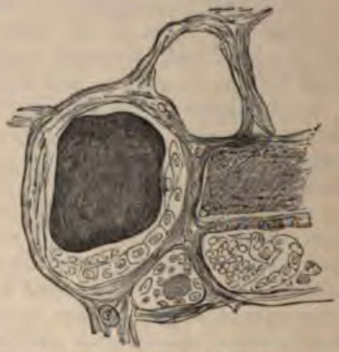
An adenoid growth may appear as a tumor within the gland itself, or connected with it, or more commonly as an intra-cystic growth, similar to that seen so frequently in the breast. In their clinical history such cases cannot well be diagnosed from the ordinary goitre, although, when the disease is unilateral, and assumes a rounded or irregular form, and appears to be an isolated outgrowth of the gland itself, the nature of the tumor may be suspected; when placed, however, within the gland itself, or within a cyst in the gland, the diagnosis is impossible. In the figure below (Fig. 61), taken from a drawing by Dr. Moxon, of an old preparation in the Guy's Hospital Museum (1711^{45}), a tumor the size of a grape is depicted hanging down loosely by a pedicle attached to a lobe of the gland. In the gland there is a well-marked, cup-like depression, from which the tumor had fallen out, the pedicle mainly consisting of a large artery emerging from the gland. The growth had an ossified capsule, and was composed of a structure like that of thyroid tissue (Fig. 62). My late colleague, Mr. Poland, has recorded a like case in which excision was successfully performed ('Guy's Hosp. Rep.,' 1871). Frerichs, Rokitansky, and Virchow record somewhat similar instances. Paget thus refers to the subject of accessory thyroid tumors: "These growths of new gland tissue may appear not only in the substance of the enlarging thyroid, but external to and detached from the gland. Such outlying masses of thyroid gland are not rare near bronchoceles, lying by them like the little spleens one sees near the larger mass. Their history is merged in that of bronchoceles (see 'Virchow,' lect. 22), with which they are usually associated, whether imbedded as distinct masses in the enlarged gland, or lying close to it, but discontinuous."

Fig. 61.



Pedunculated thyroidal tumor.

Fig. 62.



Microscopical appearance of thyroid glands. (From Dr. Moxon's drawing.)

Cancerous growths appear as infiltrating affections of the gland, or, as distinct tumors; they have no special clinical characters until they attack the surrounding tissues by continuity, or break down. The Guy's Hosp. Mus. contains four preparations of this disease.

OPERATIVE INTERFERENCE IN THYROIDAL TUMORS.

Many operative proceedings have been suggested and adopted for goitre and thyroidal tumors. Sir W. Blizard, Earl, and Coates ('Med.-Chir. Trans.,' vol. x) tied the superior thyroid arteries, with the view of starving the disease, and Coates's attempt was attended with success, but the operation is necessarily a severe one, and the free arterial supply from the inferior thyroid arteries tends to neutralize its good. At the present day it is properly discarded. Setons have likewise been used with good success for this affection, and deserve a more extended trial. Excision, however, is probably the only operation that is worthy of consideration when any operative measure at all is to be entertained. It need hardly be stated, that no surgeon would venture to recommend the removal of a thyroid gland or tumor, unless life was jeopardized from its growth, and less severe measures had failed or were inapplicable; only under such circumstances is the attempt justifiable. That it can be done successfully has been proved by Dr. W. Warren Greene, of Maine; and in the 'American Journal of Medical Sciences' for January, 1871, two such cases are recorded. Mr. Poland's case, already referred to, is another in point, and more recently that of Dr. P. H. Watson.

Hemorrhage is the chief danger to be dreaded in the operation, but if the fingers be well used to enucleate the growth, without dividing or cutting into its capsule, and if the pedicle containing the vessels which supply it be rapidly reached and ligatured, bleeding may be disregarded. As an extra point of caution it appears to be a sound practice to ligature before cutting all parts that require division in the same way as does the surgeon in ovarian cases, and for the same reason. Should the tumor turn out to be an adenoid growth, in or connected with the gland, as in Poland's case, it may be removed with comparative facility, and should it be an enlarged gland simply, even a pound and a half in weight, success may follow, as was proved by Greene's and Watson's cases. Indeed, I cannot do better than give the several steps of the operation in Dr. Greene's own words:

"1st. Exposure of the tumor by linear incision of ample length, avoiding most sedulously any wounding of the tumor or its fascia propria.

2d. Division of the fascia propria upon the director.

3d. The reflexion and the enucleation of the tumor with the fingers and handle of the scalpel, paying no attention to hemorrhage however profuse, but going on as rapidly as possible to the base of the gland, and compressing the thyroid arteries.

4th. Transfixion of the pedicle, from below upwards, with a blunt curved needle, armed with a double ligature, and tying each half, or, when practicable, dividing the pedicle into as many portions as there are main arterial trunks, and tying each portion separately.

5th. Excision of the gland, and subsequent dressing of the wound, as in ordinary cases."

Dr. P. Heron Watson, in an interesting paper on the operation ('Edin. Med. Journ.,' Sept. 1873), strongly advises that "the investing fascial sheath of the thyroid should be left undivided until the mediate ligature of the vessels included in their fine cellular sheath has been effected," and he proved by cases that this can readily be effected through the wound made for the removal of the gland. He condemns anything like roughness in the removal of the gland, and believes that the operation he advocates and had successfully performed in five cases, is easy, rapid in execution, and devoid of risk.

I cannot forbear, however, from quoting Dr. Greene's concluding remarks, which are so full of sound sense and wisdom. "I cannot refrain from one word of warning to my younger brethren, whose ambition may make their fingers tingle, lest they should, in the light of these successful cases, be too easily tempted to interfere with these growths. It is, and always will be, exceedingly rare that any such interference is warrantable, *never* for relief of deformity or discomfort merely; only to save life, and if it is, beyond all question, determined in any given case that such an operation gives the only chance for snatching a fellow-being from an untimely grave, be it remembered that accurate anatomical knowledge, and a perfect self-control under the most trying ordeals through which a surgeon can pass, are indispensable to its best performance."

SURGERY OF THE NERVOUS SYSTEM.

INJURIES OF THE HEAD.

CHAPTER VI.

CONTUSIONS AND WOUNDS OF THE SCALP.—BLOOD TUMORS.—OSTITIS.

INJURIES of the head are always of importance, and however trivial they may appear to be are never to be lightly treated. Although a blow upon the head may not be followed at the time by any symptoms of brain disturbance, and the only apparent result may be a simple cutaneous bruise, the bone may have suffered as well as the integument; as a consequence, grave results may ensue, since an acute inflammation of the diploë of the skull is a condition fraught with danger, and a chronic inflammation of the bone is scarcely less serious. When, moreover, as a primary effect of injury, evidence exists of brain disturbance, the importance of the case is increased, for brain concussion as a rule means brain bruising, and as a consequence the severest effects may follow the simplest accident. It is well for the student to have these truths impressed on his mind at the beginning of a chapter on injuries to the skull, for they have a practical bearing of vast importance.

CONTUSIONS OF THE SCALP AND BLOOD TUMORS.

The integuments of the scalp have this peculiarity, that they are intimately connected with the aponeurosis of the occipito-frontalis muscle; indeed, practically, these parts may be regarded as one, for they are not to be separated, and move together over the cranium. They are well supplied with vessels, and, consequently, have considerable power of repair, and rarely slough. A *simple contusion* of the scalp, not complicated with any great effusion of blood or other local injury, requires little surgical attention; it has a tendency to recover like contusions of other parts, although, when complicated with any great effusion of blood, difficulties arise. When any great effusion of blood complicates a contusion, a *blood tumor* is said to exist, and when this occurs on the scalp the affection is known by the term *cephalhæmatoma*. In newly-born children this affection is frequently met with and it is commonly, although not always, a result of a difficult or instrumental labor. It is usually situated over the parietal bone, showing itself as a more or less circumscribed, soft, fluctuating tumor; but the largest I have ever seen, was over the occipital bone. When the tumor is small and confined to one bone, it is probable that the blood is effused beneath the pericranium. When the swelling is larger and spread over more than one bone, the effusion, doubtless, is poured out beneath the aponeurosis of the scalp.

In the former or *subpericranial form* the indurated base may organize, or inflammatory matter may be poured out around it, and assume the character of bone, more or less covering in the swelling; and, in neglected cases, suppuration, which occasionally passes on to involve the bone itself, may follow.

In the latter or *subaponeurotic form*, in which the blood is generally rapidly absorbed, a peculiar crackling sensation, which is very characteristic, will be often given to the hand in manipulation. In feeble infants this process of absorption may be delayed, or may fail altogether; under which circumstances surgical aid is called for.

In the adult, in addition to the forms of blood tumor just described as a consequence of injury, blood may be effused into the skin itself, and appear as a hard unyielding lump.

When a blood tumor has an indurated base, rising from, and apparently continuous with, the bone, with a defined edge towards the centre, the idea may present itself that a fracture with depression exists. Under such circumstances the surgeon will be assisted in his diagnosis by firmly pressing his thumb or finger for a few seconds upon the ridge: this act in a recent case often displaces the fibrin, reveals the uninterrupted continuity of the bony surface, and thus proves the nature of the case. There will also be an absence of symptoms of fracture. When the case is complicated with brain symptoms or a ruptured artery, giving rise to pulsation in the tumor, some difficulty in diagnosis may be experienced.

TREATMENT.—In an ordinary case of contusion or of blood tumor the best application is a cold or spirit lotion; muriate of ammonia, in solution, being as good as any. When a rapidly forming blood tumor exists, which feels tense or pulsates, powdered ice in a bag should be applied, the cold preventing the flow of blood and encouraging absorption. When the rupture of a large artery, such as the temporal or occipital, is suspected, as indicated by the pulsation of the tumor and other symptoms, it may be advisable to apply pressure over the trunk of the vessel. When absorption of the effused blood does not take place, the cystic swelling should be tapped, the fluid drawn off, and pressure applied. This operation too may be repeated several times; the fluid often becomes serous. Should tapping fail, an incision ought to be made sufficient to allow of the free escape of the pent-up fluid and to prevent its re-collection; gentle pressure should also be subsequently applied on the part. In very obstinate cases the tumor may be treated as a serous cyst, and injected with iodine. When the effused blood breaks up, and causes suppuration—a somewhat rare result—a free incision is required and the case must be treated as one of abscess. During this period, tonic treatment is often required to improve the patient's powers. When the tumor is large, the patient should be kept quite free from excitement, and the diet carefully regulated according to the special wants of the case. As a rule, all such cases do well.

SCALP WOUNDS.

Incised and lacerated wounds of the scalp are very common, and when not complicated with injury to the skull or its contents, generally do well. Blunt instruments, forcibly applied, produce scalp wounds very like those caused by sharp-cutting ones. Wounds which exhibit entire hair-bulbs projecting from the surface of their sections have been probably produced by a blunt instrument, while on the other hand, when the hair-bulbs are found cut, the wound has to a certainty been caused by a sharp one. (*Vide* paper, 'Glasgow Med. Journal,' January, 1876, by Dr. Wm. MacEwen.) Large portions of the scalp may be torn away from its connections with the pericranium or bone, and on readjustment live, though much bruised and injured, the extreme vascularity of the scalp favoring its repair, and the subject of the injury may recover without a bad symptom. It is generally thought that these wounds are especially "liable to prove the exciting cause of erysipelas." I am disposed to doubt the accuracy of such an assertion, because from my notes of 175 cases of scalp wounds admitted consecutively into Guy's in eight years—and it must be added that only the severe are admitted—I find that erysipelas followed only in three, or in 1.71 per cent., this proportion being about the same as that obtaining in surgical cases generally (*vide* p. 47).

Lacerated or contused wounds of the scalp rarely slough, and should be treated as the incised. Punctured wounds are, however, liable to be followed by diffused inflammation beneath the scalp.

TREATMENT.—Under all circumstances and conditions, scalp wounds should be gently and carefully cleaned with tepid water, and their edges adjusted and maintained in position. The hair should be removed in the neighborhood of the wound, and the head kept cool. When the wound is not extensive, and its edges can be adjusted by strips of plaster, sutures are not needed; but when any difficulty is experienced, they may be as fearlessly applied to the scalp as to other parts; in extensive lacerations, indeed, the application of sutures is decidedly preferable to any other form of practice, inasmuch as with their use the wound can be kept clean and moist by water dressing, which is not possible where a quantity of strapping has been employed. In the application of the suture, however, care must be taken not to include the aponeurosis of the occipito-frontalis muscle, for there is more danger of setting up mischief in the cellular tissue beneath this tendon, when this practice is adopted, than when the sutures simply pass through the skin itself. The kind of suture is unimportant, although many surgeons prefer the metallic. All sutures should be removed on the second day, as wounds of the scalp heal rapidly.

When the pericranium is torn off and the bone exposed, no difference in practice is needed, the prospects of a satisfactory recovery under these circumstances being as good as in a less complicated case. When the bone, however, has been much injured superficial necrosis may follow. Should diffused suppuration occur in the cellular tissue beneath the aponeurosis, the sooner a free escape is given to the matter the better, as such cases are always attended with great danger to the periosteum, to the bone, and even to the life of the patient. To attain this end the edges of the wound should be separated in parts, or *limited* incisions made through the tissues to the bone. By adopting this practice early, the extension of the inflammation will often be checked, and the extent of sloughing of the cellular tissue limited. Warm fomentations and water dressings should always be applied.

When extensive sloughing takes place, there is no reason why a good recovery should not follow, if the powers of a patient are good and the kidneys sound.

The powers of a patient must be kept up by tonic medicines, such as iron or quinine, generous diet allowed, and stimulants employed when needed. Sedatives to procure sleep are also essential.

When bleeding is troublesome, the arteries should be twisted, acupressed, or ligatured; when it occurs merely as a general oozing of blood, pressure may be applied either to the wound or to the trunks of the supplying vessels. In rare cases where the deep vessels of the temporal fossa are wounded and bleeding cannot be arrested, the question of applying a ligature to the external or common carotid may have to be entertained. It has never fallen to my lot, however, to witness such a case.

Contusion of the Bones of the Skull

is, doubtless, a common consequence of scalp injuries both with and without a wound; so too is scratching or abrasion of the bones frequently combined with a laceration of the scalp. In the majority of such cases a good recovery takes place, it being the exception that a different result is met with and that acute inflammation of the bone with all its dangers, or chronic inflammation with all its difficulties follows.

Acute inflammation of the bone is a severe affection, more particularly when the diploë is involved; for the diseased action may extend inwards, giving rise to a local suppuration between the bone and the dura mater, or it may involve the arachnoid, and occasion a diffused inflammation of this membrane and the brain itself.

A chronic inflammation of the bone may be followed by very similar results, or, by a thickening of the injured bone.

During the progress of necrosis of the skull, these results are always liable to occur, accompanied by a low kind of phlebitis of the cerebral sinuses and pyæmia.

The symptoms which indicate either of these two conditions generally appear two or three weeks after the accident, and vary in intensity according to the action. In acute disease there is more constitutional disturbance and headache, passing on to general brain disturbance, convulsions, paralysis, coma, and death. In chronic disease the general symptoms are less severe, and the local milder, but persistent headache is always present. When the inflammation spreads inwards towards the arachnoid and brain, other symptoms show themselves, such as severe local pains to delirium, twitching of the muscles, convulsions, paralysis, coma, and death; the rapidity of the progress of the disease governing the symptoms. When marked rigors appear, suppuration is indicated, often of the pyæmic kind; and convulsions of an epileptic nature are frequently found in the chronic form of the disease. *Persistent headache* after an injury to the head is always a symptom demanding anxious attention, as it too often means progressive mischief within the skull. This subject will however receive further elucidation in the chapter on intra-cranial inflammation.

INJURIES OF THE CRANIUM.

There are some leading practical facts or principles which should be impressed upon the memory of every surgeon who has to deal with injuries to the head. These I have formulated as follows, believing it to be well to place them at the beginning of a chapter on such injuries.

1. A concussed brain should be regarded as a bruised one.
2. Fractures or injuries of the skull are of importance so far as they are associated with damage to the skull contents; a compound fracture uncomplicated with shaking of, or injury to, the cranial contents, being less liable to be followed by bad results, than a simple fracture associated with brain mischief.
3. The amount of injury to the brain cannot be estimated by the severity of the primary symptoms; a severe injury to the brain being frequently associated at first with slight symptoms and a slight injury with severe symptoms.
4. The character of the accident and the mode of its production furnish the best means for estimating the nature and severity of the injury, and its probable results; since a fall

upon the head from a height or a blow from a heavy weight causes a *general* injury of the brain; and a fall upon or a blow from a sharp instrument a *local* one.

5. A general shaking (concussion) of the brain, whether associated or not with simple or compound fracture, may give rise either to temporary suspension of brain functions, ending in recovery; to laceration of the membranes; to a more or less severe bruising of the cortical structure of the brain; or to laceration of its deeper substance; the amount of hemorrhage complicating the case depending upon the size, number, and healthiness of the ruptured vessels. Thus a general shaking or concussion in a healthy brain may only produce a temporary suspension of cerebral functions, when the same injury in an unhealthy or aged one, in which diseased vessels ramify, may be followed by a fatal hemorrhage or apoplexy.

6. Under certain conditions of the system, a slight concussion will be followed by a fatal secondary inflammation of the brain-coverings, while under other conditions a severe injury to the brain will be followed by no such result; in the former case the kidneys are generally diseased.

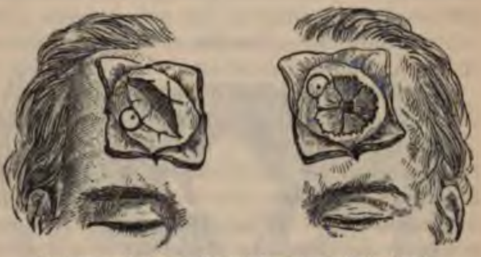
With these general propositions which the student should learn and think over as a guide, I now proceed to consider the subject of fracture of the skull.

FRACTURES OF THE SKULL.

These may be divided into fractures of the *vault* and fractures of the *base*, a third and large division including those of the *vault and base*. They may likewise be *simple* or *compound*, *comminuted*, *depressed*, or *undepressed*.

Fractures of the vault are generally caused by direct blows upon the part, or falls upon sharp bodies. They include most of the *punctured* fractures and *incised* wounds of the bone, as in sword wounds, &c. They are very frequently compound and comminuted, and the brain injury which is associated with them is for the most part local.

FIG. 63. FIG. 64.

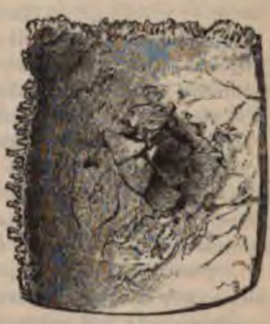


Gutter- and saucer-shaped fractures of the skull.

The fracture may appear as a simple fissure, the extent of which is determined by the amount and character of the force employed, the line of fracture being influenced by the sutures and ridges of bone. When the force is local and moderate, the fracture may be limited; when concentrated and severe, the fracture will be "starred" and generally "comminuted," the fissures radiating in all directions, involving many bones, and passing downwards towards the base. When inflicted with a blunt-edged instrument, the fracture will be depressed in a gutter shape (Fig. 63); when with a round one, as a hammer, the bone will be smashed in more like a "saucer" (Fig. 64). When the fracture has been caused by a fall from a height upon the vertex, or by a blow from a heavy body, the bones of the vault and of the base may not only be fissured bnt displaced, and the sutures even may be dislocated.

Comminuted fractures are generally the result of a concentrated local violence, and are consequently found chiefly in the vault, and are mostly compound (Fig. 65.)

FIG. 65.



Comminuted fracture of skull, with depression of inner table from direct local violence. (Prep. Guy's Mus.)

In some cases of fracture of the vault, the bone will be lepressed or driven in upon the cranial contents; in rare nstances it will be elevated, ploughed up, or displaced out-ards; a common result in sabre wounds.

The fracture will be confined in some to the outer table of e skull, in rare instances to the inner; a fracture, with epression of the inner table, occasionally existing without ny fracture of the outer. In Guy's Museum there is a specimen of fractured skull in which the outer and inner tables re both fractured, but not in corresponding parts.

The direction of the fracturing force has much to do with e form of fracture. When applied from without and with fficient violence to involve the whole thickness of the bone, e inner table, as a rule, will be fractured to a greater extent an the outer. When the force acts from within, the reverse olds good. This latter fact is best seen in gunshot fractures;

and in Guy's Museum, Prep. 1082^{70}, taken from a patient of Mr. Poland's, the point is admirably illustrated. The external table is starred, but no fracture of the internal exists; the injury to the bone having been produced by a bullet which had passed through the opposite side of the skull and struck the inner table.

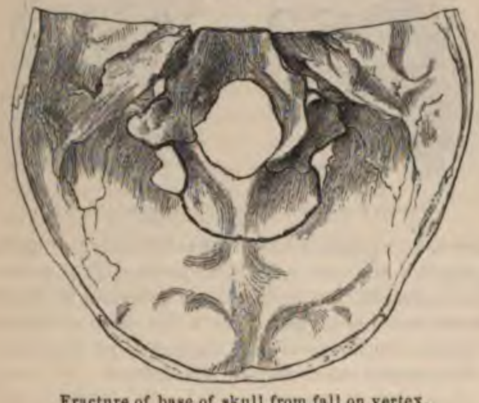
As points of practice, however, it is well to remember that, in all ordinary cases of fracture, with depression of the bones of the skull, the injury to the inner table is far greater than to the outer, and the point of exit of any foreign body through the skull is always larger than that of entrance.

Whether depression of the bones of the skull of an adult ever occurs without a fracture, is an open question. There is certainly no good evidence in support of the fact. In children it has happened without giving rise to any symptoms of brain compression; yet even here, says Mr. Hewett, "some of the bony fibres must have given way." In these cases the depressed bone may subsequently rise up again to its natural level.

The practical interest, however, attached to all these varieties of fracture is concentrated in the question as to how far the cranial contents are involved in the injury. Has the brain been slightly concussed, or so shaken as to have been bruised or lacerated? Have the membranes of the brain been torn, lacerated, or injured? Is the fractured bone a source of irritation to the dura mater? A compound fracture with or without depression, not complicated with brain disturbance or brain injury, is a cause of far less anxiety than a simple fracture in which severe brain concussion has taken place, and is indicated by symptoms; a severe shaking of the brain, whether complicated or not with a fracture, being a far more serious accident than any local injury to the skull.

Fractures of the base of the skull, or vault and base combined—for these conditions ought to be considered together—are invariably severe injuries. They are generally, except when produced by a crushing of the head, caused by a diffused force, such as that occasioned by a fall from a height upon the vertex, or by a heavy blow. "When the former the plunge of the body is suddenly arrested by the vertex coming in contact with the ground, and the entire superincumbent weight, with the superadded momentum acquired by the velocity of the fall, is concentrated around the condyles of the occipital bone, and the central compartment of the base of the skull is thus broken across." (Fig. 66.) The fracture is the result of direct violence, and not of so-called contre-coup.

Fig. 66.



Fracture of base of skull from fall on vertex.

"Thus, if the injury be inflicted by the fall of a *hard* and heavy body on the vertex, this part would be fractured; and if the weight were not very great the mischief might end there, as the resistance offered by the head may so far exhaust the momentum of the falling body that the force would not be transmitted in sufficient amount to cause fracture of the base. But if the weight and momentum of the falling body were in excess of the expenditure of force in causing fracture of the vertex, the impulse would drive the head down upon the summit of the spinal column, and fracture of the base would result; in that case, viewed mechanically, the lower fracture would be successive to the upper. But if the falling weight which struck the vertex were of a yielding material, fracture, if any, would be in the base, and not of the vertex, because the *vis inertiæ* of the skull would be overcome, and it would be driven down upon the spine, without the application of circumscribed force to the vault. The same reasoning applies when fracture of either the vault or base, or of both together, is the effect of a fall on the vertex; or this result may be varied by the blow being received on the forehead or occiput; the anterior or posterior divisions being thin, and severally more obnoxious to fracture." (F. Le Gros Clark.)

Injuries to the occiput are commonly followed by longitudinal fracture of the base, involving both the posterior and middle fossæ.

Injuries to the temporal region or about the ear are followed by fracture of the petrous bone and the middle fossa; they are always serious.

But it is rare in diffused injuries to the head to find one fossa alone involved, fissures generally passing through two fossæ, extending from the vault or part struck.

The evidence afforded by my notes of two hundred cases of fatal head injuries clearly establish these points which have also been experimentally proved by Dr. Aran.

"In precipitating a large number of bodies from various heights on to the head, Dr. Aran found that the part of the vault which first struck the ground gave, as it were, the key to the fracture which would take place at the base. Similar results were also obtained when diffused blows were dealt upon different parts of the skull by means of a large and heavy hammer. In the front part of the vault injuries thus produced led to a fracture of the anterior fossa; in the middle part of the vault they led to a fracture of the middle fossa; and at the back of the head to a fracture of the posterior fossa. In no single instance was a fracture detected at the base without a line of fracture in the corresponding part of the vault. The truth of this has been proved by an analysis which I made of all the cases of fractured base of the skull admitted into St. George's Hospital during a period of ten years." (Prescott Hewett.)

My own observations go entirely to prove the correctness of these views. The middle fossa is the one, however, most frequently involved.

Compound fractures of the skull are, as a rule, local fractures. They are generally the result of a concentrated blow upon the part, the force employed having been expended in producing the local injury. They are, consequently, often starred or comminuted and depressed fractures. When the brain is involved in the injury, it is chiefly beneath the seat of fracture; it is rarely shaken or concussed as much as it is in simple fractures the result of a diffused blow.

The dangers attending a compound fracture do not, therefore, arise so much from the direct injury to the brain as from secondary intracranial inflammation, the direct result of irritation of the dura mater by the depressed or comminuted bone; the dura mater being frequently punctured or torn by the depressed bone, and in all cases irritated. These facts have an important bearing on practice, encouraging the surgeon to remove the depressed and irritating portions of bone which have such an injurious influence on the progress of the case. When the brain is injured by the accident, the danger is far greater.

THE DIAGNOSIS OF FRACTURE OF THE SKULL.

The best guide to the diagnosis of a fracture of the skull is, doubtless, the nature of the injury. There are no special symptoms by which a fissure of the vault, uncomplicated with a wound, can be recognized. Extensive fractures of this kind are constantly found upon the post-mortem table where no suspicion of their presence was entertained during life. When a wound complicates the case, a fracture can usually be made out, as the broken part appears as a red line. Care, however, should be taken in these cases not to mistake a suture for a fracture.

When fracture exists with depressed bone, the diagnosis is rarely difficult, unless it should so happen that the fracture has taken place beneath the body of the temporal muscle, when it is almost impossible to diagnose its existence by direct signs.

An effusion of blood beneath the pericranium may be mistaken, unless care be observed, for a fracture with depressed bone; as may a natural depression in the skull, particularly in the occipital region.

Fracture of the skull, the result of a punctured wound, can, as a rule, be readily recognized, but when the point of the perforating instrument has been broken short off at the surface of the bone, much care is needed.

The diagnosis of a fracture of the base, or of the base and vault combined, is always a source of difficulty. The nature of the accident is, without doubt, the surgeon's best guide; a fall from a height upon the head, or a heavy blow, is the usual cause of such an accident, though a crushing force applied in any direction may produce the same result.

Should the fall have been upon or the force applied to the vertex, the middle fossa of the skull will probably be the seat of injury; and the diagnosis of a fracture through the petrous bone may with some confidence be made when such an injury is followed by profuse or persistent hemorrhage from the ear, succeeded by the copious discharge of a watery and perhaps saccharine or slightly albuminous fluid, and paralysis of the parts supplied by the facial nerve. Slight hemorrhage from the ear is no positive sign, the moderate discharge also of a watery fluid alone is not characteristic, nor is facial paralysis. But profuse and prolonged bleeding from the ear, or slight hemorrhage, followed by a watery discharge, is, however, strongly indicative of a fracture; as is also a copious watery discharge directly following the injury. Facial paralysis, however, combined with either of these symptoms, renders the diagnosis complete. This watery discharge is now generally admitted to be an escape of cerebro-spinal fluid through a fracture of the petrous bone, passing across the internal auditory canal, and attended with rupture of the membrana tympani. I have known this to continue for eight days.

In injuries to the mastoid process, if a local emphysema exists, the presence of a fracture may be diagnosed.

Should the blow or fall have been upon the anterior part of the skull, the probabilities of the case point to fracture of the anterior fossa; and where any injury to any of the nerves of the orbit can be made out, as indicated by local paralysis of some of the muscles of the eye, or when hemorrhage has taken place beneath the conjunctiva, the diagnosis is certain. Hemorrhage into the eyelids by itself is of no value as a diagnostic sign, although when it follows the accident at a later period and is consecutive to subconjunctival hemorrhage, it is a symptom of some importance.

Falls upon the occiput commonly produce longitudinal fissures of the base.

Copious and obstinate bleeding from the nose or pharynx is by no means unfrequent in a case of fractured base, and when accompanied with other suspicious symptoms is of diagnostic value. I have the notes of a case of injury to the head in which the patient apparently died from bleeding from the nose and mouth, no blood coming from the ear; and, after death, a fracture of the base was found, completely separating the petrous portion of the temporal bone from its connection, and laying open the lateral sinus. The right tympanum was full of blood, but the membrana tympani was entire. The stomach was full of blood, the blood from the lateral sinus having apparently found its way through the Eustachian tube into the pharynx and stomach.

I have also the particulars of a second case, in which the carotid artery was divided in its passage through the petrous bone, and the lateral sinus laid open, the lungs and bronchial tubes being found filled with blood, even down to the air-cells. Each of these lived only two hours after the accident.

Fracture of the base, unassociated with any injury to the brain itself, is of no more consequence than fracture of another part; but as the base is the most delicate part of the brain, and any injury to it is sure to be followed by severe, if not fatal, symptoms, the subject of fracture of the bones upon which it rests becomes of proportionally greater interest.

This fracture of the base may be associated with all the intra-cephalic injuries to which fractures of the vault are liable. It may be complicated with simple concussion of the brain, or with the more severe form associated with laceration of the brain-structure, or extravasation of blood upon or within the brain itself. If blood is effused there may be compression of the brain followed by death, or the same result may be produced by a secondary inflammation of the membranes and injured parts.

It is difficult upon the whole to separate the two classes of cases, inasmuch as the dangers arising from injuries to the skull do not depend upon the seat of fracture but upon the injuries to the cranial contents; and, as the same injuries may be produced by, or rather may be associated with, fractures of the base, the complications and dangers are the same in each.

Having, then, so far shown that the dangers of all forms of fracture of the skull are really alike, and that the same intracephalic complications attend fractures whether the vault or of the base, I now proceed to illustrate the special symptoms generally regarded as being diagnostic of such injuries, by a brief analysis of cases from my note-book.

Among thirty examples which are there recorded, twelve were associated with simple concussion, in all of which recovery took place. In three cases the fractures extended through the orbit as indicated by subconjunctival ecchymosis. In eight there was hemorrhage from the ears; in all, this was followed by a discharge of serum, and in seven of the cases it was associated with paralysis of the facial nerve upon the same side. In these it is quite fair to conclude that the line of fracture extended through the petrous portion of the temporal bone. In two there was bleeding from the nose; in one there was a serous discharge from the ear, accompanied by paralysis of the facial; in another this discharge followed hemorrhage from the ear, and was unaccompanied by paralysis.

To test the value of these different symptoms as indicating fracture of the base in various positions, the following analysis of the fatal cases will prove of value; and, taking the symptoms separately, subconjunctival hemorrhage will first claim our attention, as being one which more or less accurately marks a fracture through the orbital plate. In the eighteen fatal examples, this symptom was manifested in four instances; the line of fracture extending in each of these through the orbit.

In two cases there was copious hemorrhage from the ear, while in both the fracture passed through the petrous bone.

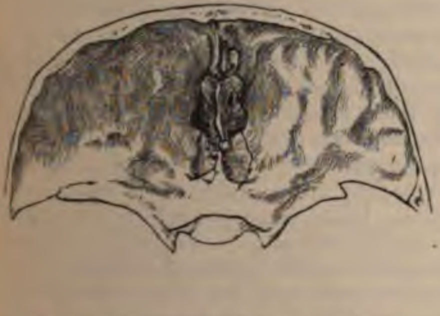
In three examples there was some epistaxis; in one of these the fracture extended across the ethmoid bone; in another the frontal sinuses were full of blood and fractured; and in the third the tympanum was found full of blood, the menbrana tympani perfect, and, upon careful examination, the lateral sinus of the brain was found to have been lacerated.

Seven of the eighteen fatal cases died from direct injury to the brain, the post-mortem examination in all revealing severe contusion or laceration of the brain-structure, with effusion of blood upon the surface of the brain or upon the membranes.

Seven other cases died from arachnitis as a result of the injury. In four of these there was contusion of the brain, and in one ecchymosis of the ventricles; in two there was no evidence of contused brain, nor was there any effusion of blood; in one interesting case the inflammation spread from the internal ear. In three, the cerebral mischief was complicated with some thoracic or abdominal injury, which caused death; and in one hemorrhage was the immediate cause of death.

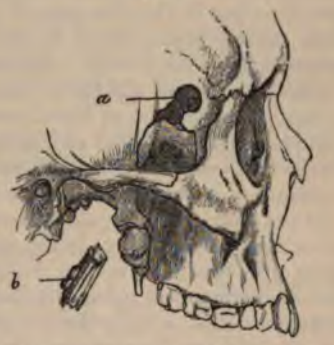
A severe blow upon the nose, by driving in the ethmoid bone, may cause fracture of the anterior fossa of the base of the skull (*Vide* Fig. 67); and I have had under my care a case in which a severe blow upon the jaw produced a fracture of the middle fossa. At St. George's Hospital there is a specimen, in which a fracture of the base was caused by the condyle of the lower jaw being driven against the glenoid fossa with such force that the condyle projected into the cavity of the skull; and in Guy's Hospital Museum there is a similar specimen, which was sent in with Mr. Hutchinson's prize essay. Punctured wounds of the orbit are by no means infrequent causes of fracture of the base; many are recorded. I was once called to a case in which a lead pencil had perforated the bone and the brain through the orbital plate; and Fig. 68 was taken from a preparation in which the frontal bone was perforated. The diagnosis of these cases is not difficult. When brain-matter escapes externally through the wound there is no room for doubt.

FIG. 67.



Fracture of anterior fossa of the base of skull.
(Prep. No. 1087^{87}, Guy's Hosp. Mus.)

FIG. 68.



a. Punctured wound through frontal bone.
b. Portion of wood which perforated bone.
(Prep. No. 1086^{80}, Guy's Hosp. Mus.)

The treatment of fractures of the skull will be described after the subjects of injuries to he brain and extravasation of blood within the cranial cavity have been considered.

CONCUSSION OF THE BRAIN AND ITS EFFECTS.

"A man receives a blow on the head, by which he is only stunned for a longer or shorter period. What is said to have happened? Concussion of the brain.

"A man dies instantaneously, or lingers some time perfectly unconscious, after an jury of the head; there are no marks of external violence. Again, what is said to have ppened? Concussion of the brain.

"The head is opened, and what is found? In one case no deviation from a healthy ucture; in another, simply great congestion of the cerebral vessels; in another, numer- points of extravasated blood scattered through the brain substance; in another, a ised appearance in some parts of this organ. In all, the case, in common parlance, is said to have been one of concussion of the brain. Such are the after-death appearances ascribed by different surgeons to concussion of the brain."

These words of an eminent surgeon (P. Hewett) so accurately describe the ordinary teaching of the schools, that I have transcribed them as a fitting introduction to the subject of which I am about to treat; not that they are strictly in accordance with pathological facts, for the experience of the post-mortem room shows that in all cases of death from concussion of the brain, some changes in structure are to be found if carefully looked for, some bruising or laceration of the brain, some bleeding into its substance. In fact, death from concussion of the brain without change of structure does not take place—*concussion and contusion of the brain being always associated in fatal cases.* At Guy's Hospital during fifteen years, no case is recorded of death from concussion without change of brain-structure.

"In every case," remarks Mr. Hewett, "in which I have seen death occur shortly after, and in consequence of, an injury to the head, I have invariably found ample evidence of the damage done to the cranial contents."

Mr. Le Gros Clark, of St. Thomas's Hospital, states—"I have never made nor witnessed a post-mortem after speedy death from a blow on the head, where there was not palpable physical lesion of the brain;" and Dr. Neudorfer, of the Austrian army, declares that he has never seen concussion, properly so called, except in apparently trivial injuries.

M. Fano, a recent French writer, has also come to the conclusion "that the symptoms generally attributed to concussion are due, not to the concussion itself, but to contusion of the brain or to extravasation of blood. In fact, all now agree that when death follows a severe shaking or concussion of the brain, contusion or bruising of the brain is invariably found.

How far these views are correct in cases of concussion that are not fatal, is an open question; but in the few cases of concussion recorded in which death has followed from other causes, some injury to the brain substance has always been found; and, in all instances in which a fatal result has taken place from secondary inflammation, evidence of some bruising of the brain has been detected. A bruising of the brain, however, with a slight extravasation of blood, may be recovered from; although with extensive effusion, compression of the brain and death are the usual result. When it is generally accepted as true that concussion and contusion of the brain are synonymous, the principles of the treatment of such injuries will be better appreciated.

In the simplest form of concussion of a healthy brain a slight and transient loss of power and consciousness is the only symptom. In the more severe form when a blow or injury produces some severe shaking of the cranial contents, this shaking is followed by a loss of consciousness more or less complete, and a loss of all power of motion; the skin of the patient will be cold, the features more or less contracted, the pulse slow and intermittent, and the pupils very variable—in some cases dilated, in others contracted, while in a third, one pupil will be dilated and the other contracted.

If the case be neither one of great severity nor complicated with any grave injury to the cranial contents, after a variable period the patient will show signs of movement; and may, perhaps, move a limb in an impatient and purposeless manner. If he is spoken to in a loud voice, he will, perhaps, show some signs of returning consciousness, either by making some inarticulate noise, or by merely opening his eyes and afterwards returning to his stolid condition.

If the case be still carefully observed, the mode of respiration may be seen to be altered; and from being slow and labored, it will be irregular, and perhaps sighing. After a time, if recovery is to take place, other signs of what are termed *reaction* will make their appearance. The skin will become warmer and more natural, the shrunken and contracted features return to their normal condition, the pulse be more regular and rapid, and moreover vomiting may occur. The appearance of this symptom being generally of moment, and the first result of a more active circulation through the cerebral centres. As the case proceeds and all goes well, the patient rapidly recovers and returns to his natural condition, feeling, perhaps, somewhat heavy and dull for a few days, and indisposed for any bodily and much less for mental labor. But if, on the other hand, the case goes wrong, the symptoms may either persist or pass into those of compression—complete insensibility, coma, and death; or, the symptoms of reaction may become excessive and run into those of inflammation of the brain or its membranes.

In this brief sketch of an ordinary example of concussion or shaking of the brain the symptoms described are of a typical kind, and have been purposely dissociated from those of such complications as are liable to occur either primarily or after the period of reaction has taken place.

What change of structure is present in such an injury is, of course, an open question. In the simplest case the local injury must be slight; in the more severe, there is every probability that some bruising of the brain has been produced, while in the worst, laceration of the brain and extravasation of blood will probably have taken place.

In what is called concussion of the brain epistaxis is very frequent, and hemorrhage into the lids of both eyes is not uncommon, though beneath the conjunctiva it is very rarely met with. Hemorrhage from the ear directly after the accident is occasionally seen, and I have known it continue for several hours, the extravasation of blood, however, taking place in all these cases as a direct result of the accident.

Again, in certain cases, a patient, having regained his consciousness, relapses into insensibility—*relapsing unconsciousness*—from which he may recover as perfectly as if no relapse had taken place. It would appear as if this condition were produced by the earliest effects of reaction, the vessels yielding too freely to the heart's pulsations, and thus producing a plethora of the part, which induces a comatose or semi-comatose condition. The following case illustrates these points.

A boy, æt. 11, having received a blow upon the head from a falling piece of timber, became perfectly unconscious and quiescent. He remained in this state for fifteen minutes, but recovering, he walked home some short distance. He soon began to feel sick and vomited, the vomiting being attended with *epistaxis*. He was then brought to Guy's, with a cold skin and laboring pulse. He was very slightly conscious and unable to answer any questions, while his limbs remained in the position in which they were placed. The pupils were dilated, but active. He was left in bed with the head raised, and a cold lotion applied to it. Warmth was also applied to the feet. He gradually recovered, and left the hospital in ten days convalescent.

The epistaxis and relapsing unconsciousness in this case, coming together at the time of reaction, point clearly to the cause.

Again, in children, reaction is not unfrequently attended with convulsions, which generally, however, pass away, and leave no mark behind. Should they appear in an adult, they are symptoms which cause anxiety, as they almost always indicate brain injury and forbode mischief.

When reaction is excessive it is attended with symptoms of fever, and brain disturbance, such as delirium, excitement, and coma; but the subject of intracranial inflammation will claim attention in another page.

Extravasation of Blood as Result of Concussion.

If the brain be violently shaken, bruising of its substance and extravasation of blood must ensue. When the injury is the result of a direct blow, the brain mischief may be only local, yet it is more usual to find the opposite side of the brain also bruised, by what is rightly termed "contre-coup," and it very often happens that the mischief to the brain by contre-coup is greater than that at the seat of local injury. When the fall is upon the vertex, the base is bruised; when on the occiput, the anterior lobe; when on the right parietal region, the base of the left middle lobe is the injured part; in fact, the base of the brain is almost always the seat of injury. In all these cases, blood will be extravasated to a greater or less degree; and when the vessels are diseased the hemorrhage may be excessive. When the extravasation of blood is upon the surface of the brain it will be either upon or within the membranes, within the cavity of the arachnoid or the meshes of the pia mater, and under both circumstances the blood will gravitate to the base. When the extravasation of blood takes place into the structure of the brain itself it may be found in any part of the cerebrum, cerebellum or pons Varolii, or into the ventricles, the extravasation rarely showing itself in the form of one large clot, but commonly in small and numerous spots of extravasation.

On referring to my notes on this subject, I find in a case of concussion, which proved fatal sixty hours after the injury, that the brain was bruised all over, and blood effused at the injured spots; the fluid in the ventricles was blood-stained, and the ventricles themselves ecchymosed. In another case of death from concussion, the result of a fall, in a man æt. 31, in whom convulsions and coma supervened on the fifteenth day after the injury, a layer of blood was found universally diffused over both hemispheres, dipping between the convolutions and passing downwards towards the base. The clot, which was shreddy, of a dull, reddish-black color, had evidently been effused for some days. The surface of the brain beneath the seat of injury was softened, and at the base, where it had been injured by *contre-coup*, similar changes had taken place. The vessels were healthy. In a third case, where the vessels were diseased and death followed from concussion, multiple extravasations were detected after death throughout the substance of the brain.

In all these typical cases, illustrating the different effects of concussion, fatal results took place from severe shaking of the brain, unassociated with fracture; but it is to be remembered that where a fracture is present, unless it be attended with depressed bone, the shaking of the brain is the source of danger.

From what has been thus stated the conclusion may be drawn that the nature of the accident is the best guide in forming an opinion on the existence of contusion of the brain as well as on its extent; although the severity of the symptoms, or their persistency, is, doubtless, a valuable indication. The French surgeons, however, look upon the following symptoms as diagnostic of a contused brain: "Tonic spasms of the limbs; intense restlessness, with constant rolling and tossing about in bed; unconsciousness, more or less complete; drowsiness, without any stertorous breathing, and in the slighter cases simply contraction of one pupil or of one eyelid; spasmodic movements about some one muscle or another of the face or lips, giving rise to a difficulty of pronunciation" (Hewett). Mr. Le Gros Clark lays stress upon the following: "More or less constant restlessness, accompanied by spasm, in which some particular member is affected, or amounting to general convulsion. If capable of giving expression to his feelings, the patient will point to some particular part of the head as the seat of pain. In some instances noisy incoherency and obtuseness of intellect accompany this condition from the first;" and these symptoms are doubtless enough to point to contusion of the brain. When they appear rapidly after the accident, they may be accepted as reliable; but when they come on a few days later they are as likely to be due to secondary inflammation of the brain as to contusion. Nevertheless, they may be regarded as valuable diagnostic indications of a bruised brain until better can be adduced.

The diagnosis of primary concussion and contusion of the brain, however, is almost impossible. The symptoms are so intermixed that the real nature of the lesion is not apparent. "The symptoms of concussion may be continued or renewed either by extravasation of blood, pus or both" (John Hunter, MS., 1787). The signs attributed to concussion, such as loss of consciousness, collapse, small, scarcely perceptible pulse, and lowered temperature, are met with in other affections of the brain, and merely indicate that the functions of that organ, and their influence on the system at large, are in a state of abeyance. It can, therefore, only be declared that the brain was contused in the first instance, *if the symptoms continue.*

The seat of injury to the brain may likewise often be indicated by some paralysis, partial or complete, of one or more of the cerebral nerves. This paralysis may be either a passing or a permanent symptom. Paralysis of the seventh pair including the facial nerve, has been already alluded to as a somewhat typical symptom of fracture through the petrous portion of the temporal bone. This may appear as an immediate result of the injury, indicating laceration of the brain by the fracture; or, what is more usual, at a later date, when it may be the effect of pressure by effused blood upon the nerve trunk in some part of its course; or, at a still later period, by inflammatory effusion.

On referring to my own notes of cases admitted into Guy's Hospital at different periods during the last twenty years, I find examples of injury to the optic nerves, as indicated by blindness; paralysis of the muscles of the globe of the eye as a whole; and paralysis of the external rectus muscle alone. Paralysis of the facial and auditory nerves is very frequent, and at times there is paralysis of the fifth nerve, as indicated by complete loss of sensation of the face, &c. Paralysis of the hypoglossal has also been observed. In the majority of these cases the symptoms appeared as a direct result of the injury; in some they came on two or three days later, associated with febrile symptoms; but in most they disappeared in the course of a few weeks. In some instances, however, of facial paralysis the symptoms were permanent. In all these there must have been injury to the base of the brain. "The coexistence of hemiplegia on one side, with paralysis of the third nerve of the opposite side is indicative of lesion of the crus cerebri on the side on which the third nerve is paralyzed." (Le Gros Clark.)

I had once under my care a man who received a severe blow on the left side of the head above the ear. The injury was followed by symptoms of concussion, which soon passed away; but he had complete aphasia. In the course of a few days he partially recovered the ability to speak, but then so thickly that he was unintelligible; in about three weeks he could be understood, but he did not recover his natural powers of speech for at least three months. During the greater part of this time he was subject to headache, which the least exercise or excess in diet made worse. There can be little doubt that in this case the base of the middle lobe of the right side had been contused. Mr. Callender tells us "that symptoms of aphasia are more apt to follow injury of a part of the left hemisphere outside the corpus striatum than any other part; that injuries to the right hemisphere are more rapidly fatal than are equal injuries to the left; and that the right-side brain lesions are more often associated with convulsions than are similar hurts at the opposite side." ('Brit. Med. Journ.,' June 6th, 1874.)

REMOTE EFFECTS OF CONCUSSION.

There are, however, many injuries to the head which, without producing any definite symptoms, such as have been described as the result of concussion, &c., yet cause serious and often permanent damage to the patient.

The effects of a blow on the head are by no means determined by the immediate symptoms resulting, for it has often happened that a person has received a trifling injury, from which he is supposed to have completely recovered, while the case has ended in a permanent enfeeblement of the mental powers. It behooves the surgeon, therefore, to be most cautious in giving an opinion as to the issue of a case of injury to the head. As his functions seldom extend beyond the early period of treatment it is not necessary here to enter much into detail in such cases after pointing the moral that attaches to them all.

The records of lunatic asylums prove, unhappily, that many cases of apparently trivial injury to the head, unaccompanied by symptoms which would indicate any positive affection, such as concussion, paralysis, &c., have ended in an affection of the brain which has rendered the patient hopelessly demented, and, moreover, has left no visible traces of the malady in the brain after death. The following may suffice as illustrations.

A boy, æt. 16, fell from a tree and was found partly insensible. After a few days' treatment he was dismissed from the hospital as "cured." In a few months he was obliged to be placed in a lunatic asylum, where he remained several years.

A gentleman put his head out of the window of a carriage while travelling by railway, and received a scalp wound from striking against a post. He was rendered insensible at the time, but soon improved. There were no signs of importance, yet in a few weeks he was in a state of mental aberration and died in a year.

A man was kicked by a horse in the stomach and fell, striking his head on the stable floor, but had no cerebral symptoms. In a few weeks he got delirious and confused in mind, and became in time hopelessly insane.

Such instances might be multiplied endlessly, all pointing to the supreme importance of injuries to the head, however slight the immediate symptoms. The reader may find this subject well discussed and illustrated by Dr. J. C. Browne in the first volume of the 'West Riding Asylum Reports,' in Abercrombie's works, and elsewhere. It may be laid down as a principle that persons with any hereditary predisposition to insanity or nervous disease are more liable to suffer from cranial injuries than others; whilst the temperate have a better chance of escape than those addicted to excesses of any sort.

Dr. J. C. Browne says in the report already alluded to, "We are justified in concluding that concussion may exert its worst influence without any organic change which is capable of being detected. Everything points to the conclusion that the evil of concussion really consists in what may be called dynamical changes in the nerve-cells and their connecting fibrils."

INJURIES OF THE BRAIN AND ITS MEMBRANES COMPLICATING FRACTURE.

When the student has recognized the fact that a blow upon the head, *not* complicated with fracture, is capable of producing, by concussion of the brain, injuries such as have been sketched in the previous pages, he will be quite ready to understand that a blow upon the head *complicated* with fracture is likely to be followed by results that are at least equally severe. He must know that, as the force required to produce a fracture of the skull is either more violent or more concentrated than that required to produce what has been described as a concussion of the brain, so there are other complications which are frequently associated with or are peculiar to fracture, such as depression of bone producing compression of the brain, extravasation of blood external to the dura mater from rupture of the middle meningeal artery, injury to the dura mater or membranes, and direct injury to the brain. He must also be aware of the fact that a fracture of the skull may take place without producing any cerebral disturbance; for example—

A man, æt. 27, received a blow over the vertex from a broken sword. An extensive scalp wound was the result, and a very evident incised wound in the upper portion of the frontal bone, apparently involving only the external table. It was not complicated with the slightest cerebral disturbance, and good recovery followed.

A boy received a compound fracture over the frontal region from the kick of a horse; he had no head symptoms whatever, and recovered.

In the former case there was an incised wound of the skull, and in the latter an undepressed compound fracture. In neither was the brain shaken, bruised, or otherwise injured, and in both a good recovery ensued. Cases such as these, however, are comparatively rare; the more frequent being examples of fractured skull associated with brain symptoms similar to those which have been described under the head of simple concussion; cases in which the functions of the brain are for a time more or less interfered with or suspended, but which have a tendency gradually to return to their normal condition; in which the injury to the skull has been severe enough to break the bone, and general enough to shake the brain and cause a suspension of its functions. The importance of these, however, lies in the injury the brain has sustained, and not upon the fracture; the fracture being only a complication, and so long as there is no depressed bone irritating and compressing the brain, the danger is in no way increased. If, however, in any given instance, the injury is complicated with laceration of one of the large arteries of the bone such as the middle meningeal artery, other conditions may arise which produce special symptoms.

Fractures of the skull associated with extravasation of blood between the dura mater and the bone.—As the result of an injury to the skull, whether with or without a fracture, small extravasations of blood between the dura mater and the bone are not unfrequent, and are due to the rupture of some of the small vessels which pass from the bone to the dura mater beneath. They give rise to no symptoms by which they can be recognized, and usually are only discovered after death.

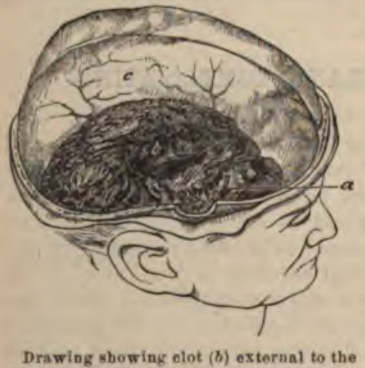
When any large extravasation occurs, the blood comes, as a rule, from the trunk or from one of the branches of the middle meningeal artery, which runs upward in a groove of the anterior inferior angle of the parietal bone, and divides to supply the lateral parts of the base and the vault of the cranium. A fissure, therefore, of the bone in these parts may lacerate one of these branches, and give rise to a hemorrhage sufficiently copious to produce symptoms of compression of the brain.

It is well to know, however, that the brain will sustain a great deal of pressure without giving rise to any symptoms, and that several ounces of effused blood rapidly poured out are required to produce such symptoms as are recognizable. In rare instances the hemorrhage may come from one of the large venous sinuses which has been torn.

The following is an excellent case to illustrate the accident:

Case.—A man, æt. 49, when riding in a gig, was thrown out upon his head. The accident produced a scalp wound over the left side of the vertex and some slight insensibility. He got up and walked for half an hour, when he became confused, staggered, and went into a shop, being supposed by the shopkeeper to be intoxicated, but as he gradually became quite insensible he was brought to Guy's. When admitted he was perfectly unconscious and comatose, with dilated pupils, laboring pulse, and slow respiration. Soon afterwards he became convulsed, the right arm being more affected than any other part, which in a few hours, however, became paralyzed. He remained in this condition for two days, and died comatose. After death, upon removing the calvaria, which was fissured in a vertical direction from the middle of the left parietal bone to the jugular foramen, a large clot of blood was seen lying upon the dura mater, clearly proceeding from the middle meningeal artery. This was about two and a half inches in diameter, and more than an inch in thickness. It formed a *globular tumor*, and caused an extensive depression upon the left cerebral hemisphere, which pressed the longitudinal fissure to the right side. The brain itself was healthy. Prep. 1606^{50} in Guy's Hosp. Mus. shows the condition. In Fig. 69 these parts are well seen.

FIG. 69.



Drawing showing clot (*b*) external to the dura mater (*c*) from laceration of the middle meningeal artery (*a*) following a fracture. (Drawing 80^{20}, from a case of Hilton's, G. H. M.)

Such a case may fairly be accepted as a typical example of this form of injury, and special attention should be paid to the fact, that the man recovered from the immediate effects or shock of the accident, remained sensible for a definite period, and then gradually became unconscious. In compression from hemorrhage this "interval of time," provided it be a short time, between the accident and the occurrence of the symptoms, is most important from a diagnostic point of view; it is very commonly, although not constantly, present; but, when present, it is characteristic of hemorrhage in some form. The symptoms, to be those of compression must also be lasting; nor must they be mistaken for the "relapsing unconsciousness" of a shaken brain, to which attention has been already directed. The persistency of the symptoms is consequently a valuable diagnostic symptom.

But it may be asked, how is extravasation of blood, the result of a lacerated meningeal artery and therefore outside the dura mater, to be diagnosed from extravasation of blood within the cavity of the arachnoid, upon the surface of the brain, or within the brain itself? For under all these circumstances the symptoms may appear some time after the accident, the inference drawn from the "interval of time" being the same in each; under all, the symptoms of compression will be identical, for they will be those of apoplexy, and, as in apoplexy, varying in each case; for "when extravasation takes place on the surface or within the substance of the brain, it is accompanied, and, indeed, produced by lesion of the cerebral texture, which lesion is mostly indicated by paralysis, by irritation or spasmodic action affecting some particular part, by derangement of the pupils, or by other symptoms." (Cock.) The surgeon's best guide, however, in forming his diagnosis will always be the history of the case, when it can be obtained, and also the nature of the accident.

In uncomplicated cases of hemorrhage *external to the dura mater* the injury is generally a local one, produced by a sharp blow or fall; the brain, as a whole, is not shaken or injured; the symptoms of compression are, moreover, generally very marked and rapidly produced, and the paralysis of half the body is also commonly complete.

In cases of hemorrhage *into the arachnoid cavity, or upon the surface of the brain*, the injury is mostly of a general character, such as a fall from a height or a blow from a heavy weight; the whole brain having been violently shaken or "concussed," and, as a result its delicate structure, more particularly that of the base, has been bruised or lacerated, weak or diseased vessels being very apt to give way, producing hemorrhage. Hemorrhage external to the dura mater may, it is true, be present in these cases of general injury, but it will be complicated with extravasation into deeper parts; and this point of diagnosis is all important, since in the former class of cases, when the blood is between the bone and dura mater, surgical treatment may be of inestimable value, whilst in the latter it can be of no service.

Hemorrhage upon the surface of the brain is a very important subject, occurring in variable degrees in every case of severe or general injury to the skull, whether complicated or not with fracture; the brain itself may be not only bruised at the seat of injury, but it will be equally, if not more, injured at the opposite point by *contre-coup;* and this bruising and extravasation are generally found at the base of the brain. The hemorrhage associated with this bruising may be so slight as to give rise to no symptoms, and recovery may take place; or it may be so great as to induce symptoms of compression. But when a large vessel of the pia mater is ruptured, the bleeding will be severe, and under these circumstances the blood may spread into all the parts down to the base, covering in the cerebellum and spinal cord.

It is this fact that renders all cases of *general injury* to the brain so serious, and tells so powerfully against any operative interference in such a class of cases, the surgeon being quite unable to reach the source of compression by trephining.

Hemorrhage into the cavity of the arachnoid is by no means a common consequence of head injury, but it may occur as a result either of a local or direct injury to the skull, or of a diffused one; and the effused blood may be poured out upon one or both sides of the cerebrum. When the effusion is gradual and not extensive, no definite symptoms of compression will be produced; but when extensive, although symptoms of compression may appear, there will be nothing to indicate the precise position of the hemorrhage.

In patients who have albuminuria, or diseased arteries, there is reason to think that a slight injury to the head may cause extravasation of blood into the arachnoid, and this fact has an important practical bearing, furnishing a key to the solution of many a doubtful case of head injury.

Pathology has taught us that blood clots may organize and form what are now known as arachnoid cysts, having smooth external surfaces like a serous membrane; which when recent, will be soft and pulpy; when old, fibrous. They may contain only serous fluid more or less blood-stained, or clots of blood altered by time. Sometimes these cysts are found to be loose in the arachnoid cavity, at others fixed to the parietal arachnoid. They are usually found *accidentally* after death in those who have suffered from mental disorder or general paralysis, and although more commonly they exist on one side of the head only, they are sometimes found on both.

Dr. Crichton Browne ('Journal of Psychological Medicine,' December, 1875) tells us that out of 1240 post-mortem examinations made at the West Riding Asylum, there were 59 examples of arachnoid cysts: 43 occurred in males, 16 in females, and the majority were in the left side. In half the cases general paralysis was the cause of death. Dr. Browne does not think that these cysts have a traumatic origin, but are due to the rupture of a vessel from cerebral hyperæmia.

To Mr. Prescott Hewett ('Med.-Chir. Trans,' vol. xxviii) must be assigned the credit of explaining how these cysts are formed from a chronic change in previously effused blood. For a full elucidation of the subject, however, we are indebted to Drs. Wilks, Ogle, Bacon, and Sutherland ('Journal of Mental Science,' vols. x and xi; 'Rep. West Riding Asylum,' vol. i).

COMPRESSION OF THE BRAIN.

The brain may be compressed in many ways; though there are four special causes of compression:—Compression from *depressed bone*, the result of fracture, simple or compound; compression from the *extravasation of blood* into any part of the cranium; compression from the *formation of matter* between the dura mater and the bone; and compression from the *effusion of inflammatory products* into the brain or its membranes.

The symptoms of compressions under all these different circumstances are much alike, although the clinical history of the cases and the date of the appearance of the symptoms after the injury vary in each class. When the result of depressed bone, the symptoms are the immediate consequence of the accident. When caused by extravasation of blood, there is almost always some interval of time between the accident and the accession of the symptoms, although that interval may be but short. When caused by the effusion of inflammatory products into or on the brain, the symptoms generally appear some days after the accident, and are gradual; and, when the result of the formation of matter between the dura mater and the bone, the symptoms rarely show themselves for two or three weeks after the accident. In both of the latter classes of cases, moreover, headache and other inflammatory symptoms coexist.

The symptoms of compression of the brain are those of apoplexy, and their severity depends entirely upon the suddenness and amount of the compression. The skull may be fractured and the bone depressed, and still no symptoms arise. Extravasation of blood may also take place to a limited degree within the skull and not be recognized. There is good reason to believe, indeed, that a considerable amount of blood may be poured out *slowly* upon the surface of the brain without giving rise to compression, the brain gradually accommodating itself to the pressure. The most marked cases of compression are usually due to rapid extravasation. When the bones are much depressed, or when the brain is suddenly compressed by the local effusion of blood, symptoms show themselves, such as complete insensibility, slow, difficult, and perhaps stertorous respiration, and a full, slow, laboring pulse. The pupils may be either dilated or contracted, but they will be always fixed, and will not respond to light. In very severe cases the respiration will be of a peculiar *puffing* character. There may also be complete loss of the power of swallowing, inability to retain feces, and retention of urine—incontinence or overflow of urine being the last symptom.

When the brain is widely and uniformly compressed by an effusion of blood or in some other way, the symptoms are "general," *i. e.*, one side is not more paralyzed than the other. When the compression is more localized, the paralysis is partial and corresponds with the region affected; though when the extravasation is extensive, even though localized, the general effect may mask the local symptoms. The best examples of this form of limited compression are found in cases of fracture of the skull from a local injury, and extravasation of blood between the bone and the dura mater. The case quoted on page 166 is a good one in point; though the following is probably a better, as it is complete.

J. P—, æt. 46, a painter, having fallen from a height upon his head on a piece of iron, received a severe scalp wound on the right side of the median line of the head, with slight concussion. He was admitted into Guy's under Mr. Cock's care in 1841, conscious, and remained so for eleven hours after the injury; four hours later he was found in a state of utter unconsciousness, with stertorous breathing and insensible pupils. He continued gradually to get worse. The left arm and leg when pinched were readily retracted. The right side was completely paralyzed. No fracture could be discovered. Trephining was performed above and behind the anterior inferior angle of the left parietal bone over the trunk of the middle meningeal artery, and a large piece of bone removed. A gush of blood then took place, and a large coagulum was removed from outside the dura mater. The deep stertor at once ceased, and the next day the man moved his right arm and leg freely, and recognized his wife. He progressed favorably after the operation, though recovery was retarded by bone exfoliation. He resumed his work and occupation, and continued in good health for thirteen years. During this period, however, he had at intervals exfoliation of some portion of the skull at the seat of injury; in the ninth year he had fits, which during the last six years of his life recurred at intervals, the attacks, as Mr. Cock reported, becoming gradually more frequent and severe in their character. Six months before his death he had paralysis of the opposite side of the body to that of the injury; the face was included in the paralysis, and his speech was somewhat affected. He died after a severe apoplectic fit. After death the brain beneath the injured bone was found softened and adherent to the skull; and it contained a recent clot of three or four ounces of blood, which filled the ventricles. "It appeared probable," says Dr. Wilks, who made the examination, "that a softening had been going on for some months in the middle hemisphere of the brain, involving the contiguous surfaces of the corpus striatum and thalamus, and that at last a rupture of the vessel had taken place, infiltrating all these diseased structures as well as the ventricles." The trephine opening was filled in by a tough membrane; and around its margins there was evidence of considerable ostitis having taken place. (Cock, 'Guy's Hosp. Reports,' 1857.)

When a patient receives a direct blow upon one side of the head, causing a fracture with depression of the bone, and attended with paralysis of the opposite side of the body and a fixed and dilated pupil on the side of the injury, the conclusion is inevitable, that the depressed bone is the cause of the paralysis, by producing pressure upon the brain; the depression must, however, be very great to give rise to such symptoms.

When a patient sustains a similar injury, with or without depression of the bone, but followed after a distinct interval of time by paralysis of one side of the body, whether of the injured side or not, it is quite fair to assume that hemorrhage has taken place inside the skull, and is the cause of the compression.

In both these cases a local injury is followed by local mischief, causing a local paralysis, consequently surgical treatment is of great promise.

When a patient receives a general injury to the head—such as commonly results from a fall upon the head from a height or a diffused blow from a heavy falling body—and this is followed directly or after an interval of time, by symptoms of compression, whether associated or not with a fracture, the paralysis is, as a rule, general; and even if more complete on one side than another, the injury to the brain is, for the most part, too diffused or extensive to admit of surgical relief. The case is clearly of a mixed nature, contusion or laceration of brain-structure being associated with hemorrhage.

When a patient suffering from brain shock with or without a fracture, is unconscious, motionless, and perhaps pulseless; has lost control over the action of the bowels and the bladder; and has a feeble respiration and paralyzed pupils, it is impossible for the surgeon to form any opinion as to the nature of the cerebral injury; because these symptoms may be the result of so-called concussion, from which recovery may take place, and not of severe brain contusion; they may be associated with bruising of the brain and extravasation of blood, not sufficient, perhaps, to cause fatal compression of the brain-structure, but enough to set up cerebral symptoms, which cannot pass away for many months under the most favorable conditions; or they may be accompanied by severe brain laceration or extravasation of blood upon or into its structure, which will prove fatal by coma. The position of the extravasation has no influence on the symptoms, although it would appear that death is very rapid when it takes place into the ventricles. The primary symptoms of severe concussion and of general compression are identical, and are often not to be distinguished; both may be the result of the same kind of accident. "But," says Mr. Hewett, "there is this marked difference: in concussion the effects are instantaneous, and in compression from extravasated blood some little, it may be very short, time elapses before the symptoms manifest themselves. In the former, also, the symptoms gradually pass off, but in the latter they become more and more marked."

"The diagnostic signs of concussion and compression are, no doubt, distinct in a certain sense, yet compression rarely exists as a consequence of violence without concussion, and both are complicated with shock. Further, symptoms of simple concussion may become developed, at a later period, into those which indicate some more serious lesion: and it is in exceptional cases only that we can identify, with any degree of certainty, the efficient and sole cause of compression. Thus, in the stunning effects which succeed a blow on the head, if we can rouse a patient from his state of unconsciousness, even for a few moments, if the breathing is calm and noiseless, if the pulse is feeble, the pupils are contracted and reflex action can be excited, we conclude that the condition is one of concussion. The intensity of the effects of so-called concussions are marked by the character of the symptoms and by their duration. The probable explanation of protracted somnolence and other evidences of brain disturbance is the presence of diffused extravasation of blood over the surface of the hemispheres." (F. Le Gros Clark.)

Again, in a general shaking of the brain, blood may be extravasated into the brain itself, and when the injury has been sufficient to produce fracture there is no limit to the amount of hemorrhage or its seat. "But in dealing with such cases, great caution is necessary in order to avoid, if possible, mixing up cases of apoplexy with those of traumatic effusions. An accident coexisting with an extravasation of blood into the cerebral substance does not necessarily imply cause and effect. The previous condition of the brain or the outpouring of blood from diseased vessels may, in fact, have been the cause of the accident." (Hewett.)

On referring to my notes I see that in a case of brain injury which lived only one hour, blood was found filling the ventricles. In another the ventricles were bruised and the septum lucidum lacerated. In other cases blood was poured out into the thalamus opticus or into the corpus striatum.

In all these the brain had been severely shaken, the hemorrhage being doubtless the result of the shake and the cause of death, while the fracture of the skull was merely a complication.

It has been already shown that concussion of the brain too often implies contusion or laceration of its structure, with extravasation of blood, and, in the same way compression indicates as serious if not more severe injury. Concussion does not by itself produce definite symptoms, and when paralysis, vertigo, sickness, or other such phenomena, arise, the inference is that there is some structural damage to the brain. Compression implies a more severe degree of the same sort of injury with effusion of blood or depression of bone. Compression of the brain, when not excessive, is seldom the *direct* cause of death. It proves fatal in the majority of cases by being the starting-point of an intracranial inflammation; since it has been proved that blood can be absorbed or encysted, and depressed bone may be gradually raised by the brain itself, or, the brain may accommodate itself to the pressure.

Compression of the brain, as a result of traumatic encephalitis, will receive attention in a subsequent page.

WOUNDS OF THE BRAIN.

In some injuries to the skull the brain may be wounded or lacerated, and brain-matter may even escape from the wound directly after the accident. Such accidents are always of a very grave nature, and, as a rule, fatal. Wounds of the anterior and upper portions of the hemispheres are the least dangerous; wounds of the posterior hemisphere or base of the brain the most so. Recovery may at times follow even after very severe injuries when no secondary inflammation takes place; but the prognosis must always be unfavorable.

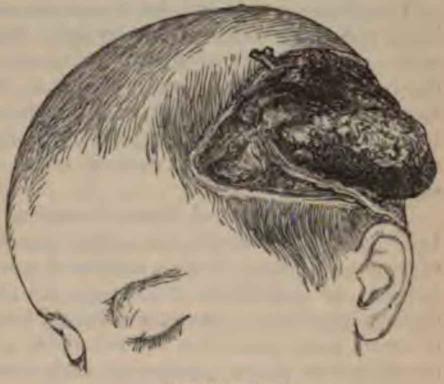
When brain-matter is pressed out of the skull in cases of fractured base, a grave injury is alway inflicted, for the crushing force must have been severe to have given rise to such a complication. Some remarkable instances of recovery after the escape of brain-matter are, however, recorded; and several have passed under my own observation, but they are too rare to be dwelt upon as holding out any hope in bad cases. Foreign bodies may likewise lodge in the skull for a long period without causing death. Wounds of the brain are not characterized by any special symptoms apart from those of concussion or compression.

Wounds of the dura mater are probably as dangerous as wounds of the brain, for inflammation of the membranes is readily set up by such injuries. It is from this fact that compound fractures of the skull are so serious; that simple fractures associated with comminution of the inner table of the skull are so often fatal; and that punctured fractures have so dangerous a tendency; for in all these cases the dura mater is not only torn, but irritated by the projecting spiculæ of bone, and secondary inflammation is the result, this inflammation, as a rule, rapidly spreading over the brain and causing death.

Wounds of the dura mater, as well as wounds of the brain, are, however, recovered from, but the prognosis in either case must be unfavorable.

Hernia cerebri, or protrusion of brain-matter alone or brain-matter mixed with inflammatory products, is always the result of a wound or slough of the dura mater, secondary either to a compound fracture or to the removal of fractured or diseased bone with the trephine. It is probably always associated with some suppuration (local) of the brain, due to extension of inflammatory mischief to that part in contact with the diseased dura mater and bone. It is to be treated with great caution. Some surgeons are in the habit of cutting off the projecting mass, others of applying pressure; but probably the best practice lies in doing very little, in keeping the parts clean and dry, and leaving their repair to natural processes; because should the local affection be so limited in its nature as to be capable of repair, the projecting mass will slough naturally after a time, and cicatrization will follow; but all interference on the part of the surgeon does harm. The best treatment is at first to apply a piece of lint to the part, and, at a later stage, to keep the hernia dry by dusting it with oxide of zinc or powdered alum. Excision and the application of caustics or pressure, do not appear to be satisfactory forms of treatment.

FIG. 70.



Hernia cerebri.

The experience of army surgeons during the American war confirms these observations.

INFLAMMATION OF THE CRANIAL BONES, BRAIN, AND MEMBRANES, THE RESULT OF AN INJURY TO THE HEAD.

In all cases of injury to the head, simple or severe—attended or unattended by fracture; —of concussion or compression; of injury to the dura mater or the brain, inflammation of the bones, of the brain, or of its membranes, is very liable to arise, and when it does, it is a very grave complication. It is this fact which makes all injuries of the head, even simple contusions of the bone, sources of danger, because inflammation, commencing in the bone, too frequently spreads inwards to the membranes of the brain and to the brain itself, and thus destroys life. The free communication between the pericranium and the dura mater, by means of the bloodvessels of the diploë, is a probable explanation of this occurrence in simple scalp and bone contusions. In injuries to the bones of the skull, and to the brain or its membranes, the liability to encephalic inflammation appears to be greatly determined by the severity of the accident.

In the present chapter, traumatic encephalitis, *acute* and *chronic*, as the result of brain shocks, whether with or without a fracture, will claim attention.

In acute encephalitis the symptoms generally appear on the second or third day following the injury, pain in the head being the most prominent symptom. This pain may be local or diffused, and is generally accompanied with intolerance of light and contracted pupils, intolerance of sound, and symptoms of febrility. As the disease progresses, wakefulness, restlessness, delirium, and convulsions will probably follow; and the patient will pass more or less rapidly into a comatose condition owing to compression of the brain by effusion, when a speedy death will ensue. The effusion takes place sometimes into the ventricles, but more often on the surface or the base of the brain.

In chronic encephalitis the symptoms may show themselves soon after the injury, but, as a rule, they do not appear for weeks, or even for months. They are most insidious in their nature; they may begin by want of sleep, with an irritability of brain and inaptitude for any bodily exertion; but headache of a constant exhausting kind, aggravated by mental or physical exertion, is a most prominent symptom. As the disease progresses the patient gradually becomes emaciated and exhausted, and, towards the close of the case epileptiform convulsions, local paralysis and coma supervene.

The *acute* cases, for the most part, are the result of a severe *general* shaking of the brain, with or without fracture, complicated with contusion or laceration of the brain-structure or its membranes. They are consequently cases of arachnitis and inflammation of the brain-substance itself, the inflammation of the membranes being general. "I have never known," says Wilks, "such an affection as arachnitis spring up as a spontaneous disease, and therefore when met with you should always look for some mischief without. When arising in this way, the interarachnoid effusion is often purulent, and so copious that it may pour out when the dura mater is removed. I have never seen extensive effusion into the interarachnoid space without an injury on the head."

The *chronic* cases are, for the most part, the result of a *local* injury and begin in the bone, spreading inwards to the dura mater, and at last involving the arachnoid cavity with its two layers of serous membrane, the pia mater, and even the brain itself; local suppuration being frequently found in these cases, either between the bone and dura mater, or in the brain itself, from extension of inflammatory action from without inwards: the whole process in the majority of instances being a local one. The same changes may take place in all cases of chronic ostitis of the calvarium, whether from accident or disease.

The acute or diffused form of arachnitis is the cause of death in most of the cases of head injury that survive the immediate results of the accident. It comes on in the stage of reaction, indeed, it may be looked upon as reaction in excess, febrile symptoms, convulsions or convulsive twitchings, delirium or mania more or less acute, terminating rapidly in paralysis, coma, and death, being the general sequence of symptoms. Effusion of serum takes place into the ventricles and upon the brain, causing at times compression; or effusion of pus or puriform lymph occurs either upon the brain itself, or in the meshes of the pia mater, or into the cavity of the arachnoid.

Whenever the brain has been severely shaken and consequently bruised or lacerated, inflammation may appear at the injured spots; hence it at times shows itself *beneath the seat of the blow*, but more frequently begins on the opposite side of the brain to the seat of injury, where the brain has been *bruised or lacerated by contre-coup;* from these centres inflammation may spread either to the membranes from the cortical structure of the brain, or to the substance of the brain itself; thus, in all cases of a general shaking of the brain, the seat of inflammation is in most cases at the base. The pia mater and cortical substance of the brain are commonly the seats of inflammation, but the cavity of the arachnoid is likewise involved in many cases secondarily by extension of the morbid action. There are no symptoms by which the precise seat of inflammation in the brain or its membranes can be made out; they are alike in all cases.

It will thus be seen that the two classes of cases of acute and chronic encephalitis are distinct in a measure. The *acute* is the result of a bruising of the brain by a severe shaking or concussion, the bruising being, as a rule, at the base of the brain by contre-coup. The inflammation begins in the pia mater, spreads outwards, and is for the most part diffused and not local. Consequently it is *beyond* the reach of surgical operation.

The *chronic* is generally the result of a local contusion or fracture of the bone, and local in its action. It involves the dura mater by extension from without, and the arachnoid, pia mater, and brain consecutively in the same way. It is consequently *within* the reach of surgical art, particularly in its early stage.

TREATMENT.—Acute encephalitis, when following a general injury to the brain, for the most part runs such a rapid course that there is little time for treatment to take effect. It attacks patients, moreover, who have been already knocked down by the injury in more ways than one, in whom there is rarely much resisting force, and there is consequently not much chance of success by treatment.

The head must, of course, be shaved and raised on a pillow, and ice should be applied to it, for there is no remedy more valuable than the application of ice in traumatic inflammation of the head. The ice when applied in a bag must be broken up into small fragments, while the bag containing it should be large, in order to cover the whole vault of the skull. The ice-cap or india-rubber coil is also good. The cold douche is a powerful remedy and has been highly spoken of. Free purging should then be resorted to, the old dose of calomel mixed with butter introduced into the mouth being probably the best form; or an enema of turpentine or castor oil may be administered.

With respect to bleeding, much caution is required. It has been little used of late years in head affections; though in a strong man, when acute encephalitis has come on after a slight injury, it is certainly a sound practice. It should be performed boldly and freely at the early part of the disease, so as to take effect upon the patient—during the state of excitement, before brain oppression has appeared, and effusion taken place. In severe general injuries it is useless. Some employ leeching and cupping on the nape of the neck, and speak highly of the practice.

Calomel, given in small and repeated doses to touch the gums, combined or not with opium, has its advocates, and patients, doubtless, have recovered under its use. The gray powder in three- or four-grain doses with five grains of Dover's powder, is a useful combination when delirium is present; and at times larger doses of opium or morphia may be given. Great care, however, must be observed in the use of these drugs, for unless they are carefully given and their effects watched, they are injurious.

French surgeons still employ blisters to the scalp, but these cannot be compared in value with the local application of ice in the early stage of the disease. In the chronic stage they may be beneficial. When they are employed they should be applied to the nape of the neck, and where mercury is relied upon, the latter may be used in the form of an ointment to dress the blister. Antimony is still given by some surgeons of eminence. I have no experience of its use, and therefore cannot recommend it. When recovery takes place—a rare result—the patient must be cautioned as to the future, for any excess of diet or of mental or physical exercise may produce a relapse. The greatest quiet ought to be observed for many weeks, and the patient should live on the simplest food. Milk diet and animal broths are sufficient for some time, solid animal food being taken with great caution. Stimulants should only be administered if the patient's powers are feeble.

When indications of compression of the brain follow these inflammatory symptoms, surgical treatment may be called for, but only when strong evidence of local compression exists.

When the symptoms are the result of *acute* encephalitis, and, consequently, of a general injury or shaking of the brain, there is little doubt that its compression is due to the effusion of inflammatory fluid into, upon, or beneath the brain, and under such circumstances the question of surgical interference should not be entertained. It is to be thought of only in cases of local *chronic* suppuration, when as has been already shown, the symptoms are the result of a local contusion of the bone, of injury, or disease, and the seat of suppuration is usually between the bone and the dura mater. At times, however, a local abscess is formed in the cavity of the arachnoid; and under the circumstances when strong evidence of this condition exists, the parietal layer may be punctured, good results having followed this practice.

In more advanced cases, suppuration may even involve the brain itself; and it is a serious question whether a surgeon is ever justified in puncturing this organ with a view of laying open the suppurating cavity. Should, however, good evidence exist of suppuration in the cerebral hemisphere beneath the seat of injury, I have no doubt as to the surgeon being justified in making an exploratory puncture, for Mr. Holden has recorded in 'St. Bartholomew's Hosp. Rep.' for 1873, a case in which success followed this practice, and in the 'American Journ. of Med. Science' for July, 1873, five other successful instances may be referred to, but the evidence must indeed be strong to justify such a measure. Dupuytren had a successful case of the kind, and pathological anatomy furnishes examples in which such a practice might have been of use. On the other hand, many bold attempts are on record in which surgeons have punctured the brain to relieve symptoms of suspected suppuration in its substance. Weeds's case is without doubt the best, as it was successful ('Nashville Journ. Med.' April, 1872), but Detmold's and Maisonneuve's are encouraging.

Still, in such cases much may be done—more, indeed, than is usually attempted—for the relief of symptoms, and I am disposed to think, that surgeons are too apt to leave these cases alone too long, and allow them to get beyond relief.

A man receives a blow upon the head, followed by passing symptoms of so-called concussion; he has a slow convalescence, attended, and perhaps followed, by headache. He may display some irritability of brain, inability to do much work, or to undergo any physical fatigue; some febrile disturbance may perhaps manifest itself, but as often as not none appear. The pulse probably will be feeble and irritable, at other times slow and laboring. On examining the seat of injury tenderness on pressure may be experienced, and occasionally increase of heat will be felt. Pressure upon the injured part may even excite a convulsion where such had previously occurred.

Under these circumstances, which are fairly indicative of local inflammation of the bone, spreading inwards—though how far is uncertain—a free incision to the bone is of great value. I have known this operation relieve immediately all the symptoms, general and local, and have never known it followed by harm. It should always be performed when evidence of local inflammation exists, with undefined and persistent brain symptoms.

When, however, evidence exists that the inflammation has spread from the bone to the parts beneath, as indicated by marked symptoms of feverishness, severe headache, and probably rigors; with sleeplessness, delirium, convulsions, and paralysis, particularly when hemiplegic, other surgical treatment may be thought of; for if these symptoms are associated with such a history as has just been sketched, there is every probability that suppuration exists within the skull, and that surgical art may reach it. General treatment, moreover, in these cases is both unsatisfactory and unsuccessful; and, if the case be left alone, bad results always follow. Surgical interference, it is true, as a rule is not very satisfactory, though some striking examples of success exist. In the hands of Pott, trephining the skull for matter beneath the bone outside the dura mater yielded a good result in five out of eight cases. No modern surgeon, however, can show a like success; "indeed," says Mr. Hewett, "the successful issue of a case of trephining for matter between the bone and dura mater is, I believe, all but unknown to surgeons of our own time." Nevertheless, the operation is clearly justifiable under such severe circumstances as have been described; although I cannot help feeling that Mr. Hewett's opinion is true, and that surgeons are too readily disposed in these cases of local encephalitis to wait too long, to trust too far to nature's own processes, and by so doing, to allow the local suppurative action to spread inwards beyond the dura mater to the brain itself, when the prospects of a successful result are certainly poor. They wait for what are called well-marked brain symptoms—coma and hemiplegia—before they interfere; which well-marked symptoms too often mean fatal brain complications. Trephining the seat of injury, therefore, under such circumstances is clearly justifiable if not hopeful, and the operation should be performed as soon as it is manifest from the history of the case that the local action is spreading. When pus is found between the bone and the dura mater great hopes may be entertained of a successful issue, although when the same suppurative action has involved the cavity of the arachnoid and the brain, the prospect is not good.

Should no pus be found, however, between the bone and dura mater, is the surgeon justified in opening the membranes? Without doubt he ought under certain circumstances, when, by the symptoms, there is strong reason to believe that pus exists beneath the injured bone; when the dura mater on exposure *bulges* firmly into the opening in the bone which has been made with the trephine, and if it be *tense*, as well as absolutely *pulseless;* for cases of success after this operation have been recorded by Guthrie, Roux, and Dumville. The evidence required to sanction any incision into the brain in search of suppuration, as has been already stated, must, however, be very strong; nor have I ever seen an instance in which it was justifiable.

Acute encephalitis, as a result of blood-poisoning, needs only to be mentioned. It is a hopeless condition from the first, and is always associated with the worst and most general form of pyæmia.

TREATMENT OF CONCUSSION AND COMPRESSION OF THE BRAIN, AND OF FRACTURES OF THE SKULL.

"A mere crack in one of the bones of the cranium, *abstractedly considered*, is not more likely to produce any serious complaints than a simple fissure in any other bone; and if symptoms of consequence do frequently attend the accident, they proceed either from the bone being beaten inwards, so as to press upon the brain, or from the mischief done to the parts within the skull by the same force that broke the bone itself. The same violence which breaks the cranium may occasion a concussion of the brain, an extravasation of blood in or upon it, or subsequent inflammation of that organ and its usual consequences." (Sam. Cooper.)

The truth embodied in this extract renders it necessary to consider the treatment of head injuries as a whole; since it is impossible to say, in any case of severe injury to the skull, whether two or more of the conditions mentioned are not associated.

When brain concussion has taken place, it may or may not be associated with fracture; and it may or may not be followed by symptoms of compression, either from extravasation of blood or secondary inflammation. When a fracture is known to exist either with or without depression of bone, the difficulty is not lessened; the brain symptoms may be simply those of a passing concussion, or they may be those of a much more serious injury, such as brain contusion, laceration, or blood extravasation. The severest complications are often ushered in by the mildest symptoms; and therefore the surgeon should always treat every case of injury of the cranium and its contents as serious, as also to be as guarded in his prognosis as he must be uncertain in his diagnosis. "We know not what injury may have been sustained or what symptoms may supervene; we therefore wait for the subsidence of the first impressions, or the development of fresh mischief, and shape our course accordingly." (Cock.)

In any case, therefore, of concussion, however slight, the patient ought to be kept quiet for a few days, observe moderation in diet, and particularly in the use of stimulants. If he moves about it is at a risk—a risk of secondary inflammation of the concussed or shaken brain, which may prove fatal.

In severe concussion, that is, after an injury to the head which is followed by a more or less complete suspension of the functions of the brain, whether with or without a fracture, equal care is needful. Should the collapse indicative of the first stage be severe, it may be necessary to hasten reaction by means of warmth to the body generally, more particularly to the feet, and by the application of some stimulant to the nostrils. It is seldom right to do more than this; because if reaction does not reappear naturally, or is not hastened by the means mentioned, it is tolerably certain that the brain mischief is of a severe if not fatal character. Under these circumstances, any more powerful means, such as the administration of alcoholic stimulants or powerful enemata, are likely to excite reaction to excess, and thus encourage secondary hemorrhage or inflammation within the skull.

When *reaction* has set in after the collapse—the *second stage* of authors—every source of excitement, mental or physical, should be removed. The patient should be kept in bed with his head raised and shaved, and the bowels emptied with a mild saline purgative, or a mercurial purge. If the head be hot, the pulse rapid, and other symptoms of general febrility and brain excitement show themselves, cold lotions or an ice-bag may be applied, and particularly the latter. When the symptoms of excessive reaction are persistent, the commencement of traumatic encephalitis should be suspected; and under these circumstances active treatment is doubtless required, inasmuch as when acute symptoms of inflammation of the brain or its membranes appear, paralysis and a fatal coma are not far off.

Venesection boldly performed at this stage of the disease, so as to affect the pulse, is a good remedy. It may even be repeated should the symptoms return and the pulse and temperature rise. In feeble patients, however, bleeding is inadmissible, and under all circumstances it ought only to be resorted to after careful consideration.

Ice to the head or a stream of cold water passed over it are means that ought never to be neglected. Powerful purgation, also, is valuable. The diet should be liquid and of a simple kind. Milk, when it can be taken, is the best, but when it cannot, weak beef tea or broth should be given, and then only in moderation.

Concussion of the brain, complicated with either simple or compound undepressed fracture or fracture of the base, is to be treated upon like principles, with equal persistency and care, for simple fractures of the vault, compound fractures of the vault, and simple fractures of the base or of the vault and base combined, *unassociated with displacement*, require no special treatment beyond that indicated by the brain symptoms.

It should be here stated that the treatment of all these conditions is to be continued for at least a month or six weeks after the injury, because many are the cases on record in which secondary inflammatory symptoms appeared at least a month after the accident, or after the subsidence of the primary symptoms.

Treatment of compression.—When the brain symptoms following an injury to the head partake more of the nature of compression, that is, when they are persistent in their character, and, instead of going on towards recovery, or the restoration of the natural functions of the brain, tend rather towards their more complete abeyance; other questions of treatment come before the surgeon, and the most important has reference to the fact whether surgical art can do anything towards relieving the condition.

The student who has carefully read the remarks that have already been made can now understand, when the injury to the brain or skull has been the result of some *general injury*, such as a fall upon the head from a height, or a blow from a heavy body, that the brain mischief which follows is certain to be of a general character, and when symptoms of local mischief complicate the case, little good is to be gained by treating these local symptoms when others of a more general or fatal character exist. In examples of brain or skull injury, therefore, as a result of diffused or general shaking of the head and its contents, local interference of any special character is generally useless.

In *local* injuries, however, the question may be seriously discussed.

In cases of *depressed fracture*, ought the bone to be elevated? and should the fact of the fracture being compound influence the decision? I have no hesitation in answering both questions, and asserting that in neither instance ought surgical interference to be thought of unless the symptoms of compression are marked or persistent; for experience has taught us that depressed bone *per se* may exist to a great degree without giving rise to any serious brain complications, and that when even brain symptoms follow as an immediate result of the injury, they may all pass away.

Should, however, the symptoms indicate the presence of effused blood beneath the fracture, sufficient to cause compression of the brain, as shown by the lapse of an "interval of time" between the accident and the symptoms; and should local paralysis point out its seat; surgical interference is called for, and in both simple and compound fractures the trepine may be required in order to elevate the bone. The operation is necessary on account of the brain symptoms present in the case, and has no reference to the character of the local injury,—to the presence or absence of a scalp wound.

In *compound fracture* of the skull, however, associated with *depression and comminution* of the bone, both with or without brain symptoms, the surgeon ought to remove loose pieces of bone, and may elevate the depressed portions when this can be done with the elevator without difficulty, as splintered bone is always a dangerous body when in contact with the dura mater.

When the brain is injured the same course should be followed, the greatest care being observed not to add to the irritation by any rough manipulation. Should difficulty be felt, however, in removing bone it had better be left *in sitû* rather than by interference incur any extra risk of injuring the brain or its membranes.

Should there be, on the removal of the bone, severe hemorrhage from a meningeal artery, the piece should be left; and should this practice fail to arrest the bleeding, a small piece of sponge inserted beneath the bone may succeed, or the application of a pair of spring forceps may be called for. It is not often, however, that such a complication is met with.

In all cases of *punctured fracture* of the skull trephining should be resorted to.

It thus appears that in simple or compound *uncomminuted* depressed fracture from a local injury no operative interference is called for, unless associated with marked symptoms of compression of the brain, or extravasation of blood between the bone and the dura mater. In compound *comminuted* fracture, also in *punctured* fracture, with or without symptoms of brain compression, it is wise to elevate the bone and remove all fragments. In other cases, as in fracture of the base, no surgical interference can be justified.

Did space permit, many instances might be quoted to illustrate these points. Cases of fracture of the skull with depressed bone, in which recovery has taken place, are numerous; indeed, it is most remarkable how much depression of the bone may exist without giving rise to brain symptoms, and I am almost tempted to believe that depressed bone by itself never gives rise to marked symptoms of compression, and when these are present hemorrhage exists with it.

Many cases might also be quoted illustrating the value of surgical interference in compound fractures with depression; I give the following: Compound fracture of skull with depression from local injury. A feeling of permanent weight on the head was the only symptom, which was at once relieved by removal of the bone, and recovery followed.

Compound fracture of skull with depressed bone from local injury. Constant vomiting, and pain in the head which was relieved at once by removal of the bone; the patient recovering on the fourth day.

Compound fracture of skull with depressed bone from local injury. Persistence of symptoms of oppressed brain. Elevation of depressed bone; and rapid recovery.

THE OPERATION OF TREPHINING OR FOR THE ELEVATION OF DEPRESSED BONE.

"Much has been written and said on the treatment of injuries to the head; and the result of modern experience and judgment has so far altered the practice of our predecessors, as to render us cautious of inflicting an additional injury on our patient for the sake of gratifying an impertinent and useless curiosity as to the exact nature and extent of the original lesion." Thus wrote my colleague, Mr. Cock, nearly thirty years ago, and what he then said is true now, although, perhaps, surgeons at the present day are less disposed to trephine in head injuries than they were even at that time.

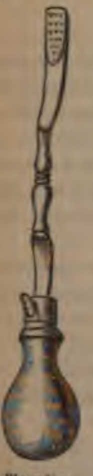
At Guy's Hospital trephining and elevation of bone for head injuries have been performed in fifty-one cases during seven years, and of these only twelve recovered. At St. Bartholomew's Hospital it was recorded by Callender in 1867, that the operation had not been performed for six years. At University College, Erichsen gives six cases of recovery out of seventeen.

The operation is likely to be of use in two classes of cases:

First.—To relieve compression of the brain from depressed bone or from extravasation of blood.

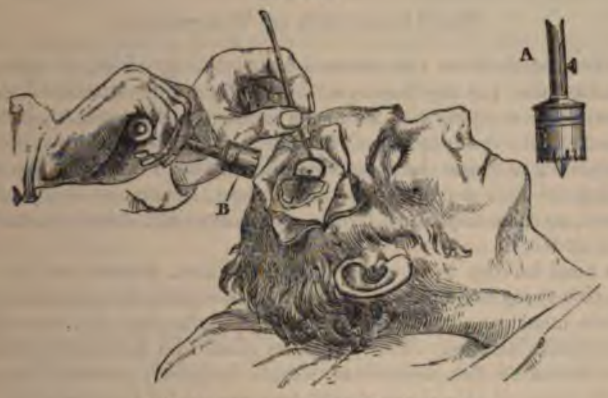
Secondly.—To prevent, check, or relieve irritation of the brain or its membranes when caused by (1) depressed and comminuted bone, by (2) inflamed and swollen bone (whether the result of accident or disease), or by (3) an accumulation of pus between the bone and dura mater compressing the brain; and, it may be stated, at once that the operation of trephining gains more support from the second than from the first group of cases.

FIG. 71A.



Elevator.

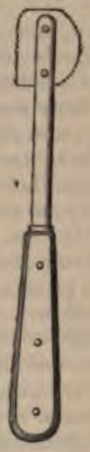
FIG. 71.



Showing the operation of Trephining.

A. Trephine prepared for use, with centre pin down.
B. With centre pin withdrawn, the outer table having been divided.

FIG. 71B.



Hey's saw.

With respect to the first it will have been gathered from preceding chapters that depression of the bones of the skull is rarely sufficient of itself to give rise to persistent symptoms of compression; that when it is, the injury has probably been of such a severe nature as to produce grave intracranial complications, from which any operation would be incapable of affording relief; and that hemorrhage between the bone and the dura mater is rarely so uncomplicated with brain mischief as to render it probable that the operation of trephining will be successful.

When, however, it can be fairly determined that brain symptoms of a defined and aggravated character are the result of either of these two causes, separately or combined, the operation of trephining may be performed. In diffused injuries of the skull the probabilities are all against the operation; while in local injuries they are in its favor.

In both simple and compound fractures of the skull, with or without depression of bone, the symptoms of compression of the brain, as a primary result of the accident, must be very marked indeed to justify the operation of trephining; although in *compound fractures* it is expedient to elevate depressed bone, when any symptoms of brain irritation manifest themselves, such as local pain and weight, spasms or convulsions; and that under all circumstances it is best to remove fragments when the bone is comminuted. In a compound comminuted fracture of the skull the dura mater is probably exposed, and is likewise irritated by the broken bone. A careful elevation of the depressed portion of the bone and the removal of the comminuted fragments can in no way add to the mischief, but must tend towards its diminution.

In *local injuries* whether simple or compound, when incipient symptoms of brain irritation or inflammation appear two or three days after the injury, the use of the trephine is indicated, inasmuch as there is a probability that the symptoms originate in the presence of a fragment of bone irritating the brain or its membranes, which if left must go on to set up encephalitis.

In all cases of *punctured fracture* the trephine should be employed.

In *diffused injuries* to the cranium and its contents trephining is useless.

When an abscess can be made out as existing between the bone and the dura mater after a head injury, the operation of trephining is demanded, though the diagnosis of such cases is difficult. The chief indications are found in the prolonged period which frequently elapses between the injury and the supervention of the symptoms, their gradual and, it may be said, irregular approach, the general and cerebral irritation that is present as a rule, the exacerbation of all these symptoms, and, above all, the constant headache.

The direct symptoms of compression produced by the formation of pus are, moreover, in no ways so definite as those afforded by blood extravasation; they are of a less decided nature, and are never associated with the deep-toned stertor and rapid progress of the symptoms, "which, with overwhelming influence, quickly annihilate both motion and consciousness when blood has been poured out in any considerable quantity after injury to the cranium." (Cock.) They are, however, fairly marked by the clinical history of the case, and can be generally recognized.

The Operation of Trephining.

The instruments required for the operation are the *trephine*, or circular hand-saw, of which there are two sizes; a *small saw*, with a straight and circular edge, generally known as Hey's saw; a *sharp scalpel*, with a handle rounded at the end, to press back the periosteum and soft parts from the bone; a *flat probe*, thin enough to introduce into the groove made by the trephine, to guide the surgeon in his attempt to perforate the bone, and to prevent him going too for; a pair of *cutting forceps*, to remove sharp points and edges of bone; *an elevator*, to raise depressed bone; and dissecting, dressing, and torsion forceps. (*Vide* Figs. 71A and B.)

The patient's head having been placed upon a pillow, *shaved* so far as requisite, and held firmly, the first thing the surgeon has to do is to expose the bone he wishes to perforate or elevate. This must be done freely, either by enlarging the wound that previously existed or by a crucial incision. The soft parts should be divided by one cut down to the bone, and these, including the periosteum, should be gently pressed back with the handle of the knife. Bleeding at this stage should be arrested by ligatures, torsion, or the application of a cold sponge and pressure.

Supposing the case to be one of fracture with depression, and that fragments of bone exist, they should be removed, great care being taken in their removal not to twist the broken bone, and thus run the risk of tearing the dura mater; and when an opening is thus formed, the depressed bone may be raised by means of the elevator carefully introduced beneath its free border. To facilitate this proceeding, perhaps the removal of a piece of projecting bone by forceps or Hey's saw will be found beneficial, and if so the trephine is not required; for the surgeon's object, under these circumstances—to raise the depressed bone and remove the comminuted portions—may be completed without the trephine.

Should the bone be so depressed, however, as not to present an edge for the surgeon's forceps, as is seen in the "gutter" fracture illustrated in Fig. 63, the trephine must be employed. The instrument should be previously prepared, the central pin being made to project sufficiently far to perforate the external table, and so fixed as to allow the saw to bite the bone. (Fig. 71A.) In a depressed fracture this pin *should never be placed upon the fractured*, but upon the border of the sound bone. The instrument is then to be applied, and the external table cautiously divided with a few semi-rotatory movements of the surgeon's wrist. A groove having been made deep enough to allow the saw to work steadily, the instrument is to be removed and the central pin withdrawn and fixed (Fig. 71B), as it would be a fatal error to go on working with the pin projecting through the inner plate of bone into the dura mater. The surgeon ought now to proceed with the utmost caution; and feel his way every few turns with the flat probe, for as soon as he has divided or even reached the inner plate the elevator may be employed and the loose ring of bone removed. When the inner plate is fractured to a greater extent than the outer, it may not be necessary to divide it, the removal of the external table with the diploë being sufficient to allow of the introduction of the elevator, and the elevation of the depressed inner table or the removal of fragments. Should this not be the case, however, the inner table must be perforated, for the whole thickness of the bone must be removed. The operator cannot be too careful at this stage of the operation; and should always proceed with the conviction that the bone is thinner at one spot than at another, and further, that "there is only the thinness of paper between eternity and his instrument." (Sir A. Cooper's MS. Lectures.) The depressed bone may then be raised by the elevator.

If the operation has been performed for extravasation of blood beneath the bone, and a clot be discovered, it should be removed; the utmost gentleness being used. Should pus exist, it will escape naturally.

Should troublesome hemorrhage from a meningeal artery ensue it may be arrested by tucking a small portion of sponge or a small piece of wood beneath the vessel and compressing it against the bone, or it may be held by a short pair of spring forceps against the bone. Free bleeding of this kind, however, is not frequent.

If, however, no blood or pus be found external to the dura mater, and strong evidence exist that it is placed beneath this membrane, the dura mater may be punctured. This step, however, is not to be undertaken without grave consideration. Yet, it may be asked, if the operation fail in its object, is the operator ever justified in making a second opening into the skull, in search of blood or of pus? Certainly it must be answered not at a hazard, although when there is evidence to point to a second position in which it is reasonably probable that the offending fluid may be found, a second perforation may be performed; cases are on record in which three or more pieces have been removed with a good result.

The wound, after the operation, must be treated on general principles; the edges of the soft parts being gently brought together, but not stitched; water dressing is the best application, and the head should be kept cool by the ice-bag. If the parts heal, and the case does well, a metallic shield will probably be required as a protection, although it is interesting to see how firm the membrane that fills in the cavity becomes after a time.

Should a hernia of the brain follow at a later stage, the same local treatment should be employed. Excision of the projecting fungous mass is a practice that is not advisable. The whole will probably wither by natural processes if a cure takes place, and the less the surgeon interferes the better.

General Conclusions on Injuries of the Head and their Treatment.

1. Injuries of the head are of importance only as far as they involve the cranial contents, a case of simple uncomplicated fracture of the skull being of less danger than one of general concussion of the brain.

2. A slight concussion of the brain, which manifests itself by a slight or passing suspension of the cerebral functions, associated or not with a fracture of the vault or of the base of the skull, generally does well.

3. A severe concussion or shaking of the brain associated or not with a fracture of the vault or of the base of the skull, is liable to be associated with contusion or laceration of the brain substance, either upon its surface or within its ventricles, and with more or less extravasation of blood; when the vessels are diseased, a copious hemorrhage often follows a slight injury.

4. In cases of severe concussion, the brain is at least as much injured by *contre-coup* as it is at the seat of injury, its base suffering the most. Fracture by *contre-coup* does not take place.

5. A fall upon the vertex from a height, or a blow upon the head from a blunt instrument, may or may not be followed by fracture of the skull, such an accident producing, as a rule, a general concussion of the brain, with such complications as contusion or laceration of the brain and effusion of blood either upon its surface or within the ventricles.

6. Falls upon a pointed object, or blows with a sharp instrument, are, as a rule, followed by local fracture; and if the brain be injured, it is at the seat of injury. As a consequence, the symptoms may be accounted for by local causes only, and the surgical treatment should be directed by local considerations.

7. When symptoms of compression of the brain immediately follow an injury to the skull which has been produced by a fall from a height, or by a blow from a heavy and blunt instrument, the cerebral injury will be general, the brain will be contused and lacerated, particularly at the base, by *contre-coup*, and if extravasated blood be found external to the dura mater, blood will also be found upon the surface of the brain, or within its membranes. The operation of trephining under these circumstances can be of no avail.

8. If symptoms of compression of the brain follow a local injury produced by a fall upon a sharp object, or a quick blow from a pointed one, such symptoms, as a rule, are produced by local causes, such as depressed bone, or extravasation of blood from a ruptured vessel, and such local injuries should be treated by the elevation of the depressed bone or by trephining.

9. When compression of the brain follows a local injury over the course of the meningeal artery, and the symptoms come on after reaction has been established, and the lapse of an interval of time from the receipt of the injury, although no depressed bone be present, the operation of trephining may be performed.

10. Encephalic inflammation may follow any concussion or injury to the brain, however slight, whether complicated or not with fracture; the danger of such a result being in proportion to the encephalic injury. In cases of contusion or laceration of the brain with extravasation of blood, it is almost sure to occur, and, as a rule, will cause a fatal termi-

nation. This inflammation may appear within a few hours of the accident, or it may be postponed for a few days; it may be very rapid in its course, or very insidious in its nature. If the brain alone be affected, either a diffused or local abscess may result; while if the membranes are involved, effusions, convulsions, general or partial paralysis, coma, and death, will rapidly take place.

11. Fractures of the base of the skull may take place alone, and be marked by only special symptoms. They may be associated with, and are generally found in, all cases of severe fracture of the vault, when produced by a heavy fall or blow, the fissures radiating downwards in a direction parallel to the forces employed.

12. Fractures of the base may be complicated with encephalic injuries similar to those which complicate fractures of the vault, consequently they may be manifested by general as well as special symptoms; and in severe cases the former completely mask the latter.

13. All injuries to the head should be treated with extreme care and always regarded as serious. Rest in the horizontal posture, freedom from excitement, bland, nutritious, unstimulating food, being essentials under all circumstances; the great principles of practice consisting in warding off excess of reaction and inflammation of the cranial contents.

DISEASES OF THE SCALP AND CRANIUM.

Besides the blood tumors of the scalp to which attention has been already directed, the head is very frequently the seat of the common skin or *sebaceous tumor* which is called a "wen," these morbid growths, indeed, are more frequently found on the head than on any other part of the body. They are more common also in women than in men, seventy out of one hundred and seven consecutive cases of sebaceous cysts which I have analyzed having occurred in women, and eighty-four on the head. In many instances these wens are doubtless due to an obstruction of the duct of a sebaceous follicle, as the orifice of the duct is often visible, and through it the contents of the cyst can be squeezed; while in others no such obstruction can be made out, it being probable that some of these tumors are new formations—true adenoid tumors of the skin, when the tumor lies beneath the skin, but has no connection with it. In *congenital* sebaceous tumors, this position is very common, although perhaps the cyst is more frequently situated beneath the fascia, or even beneath the muscles, of the part. When about the orbit—their most common seat—these cysts are always deeply placed, and often have close connection with the periosteum. They, moreover, almost always contain hair. By their pressure upon the bone they at times cause its absorption and perforation. The contents of these cysts vary; in some the secretion is milky, in others more solid and cheesy, and in a third the contents are cretaceous. When degenerating, they may be filled with a blood-stained blackish fluid, and at times are most offensive, having a peculiar sour smell.

In neglected examples of this disease the contents of the tumor may soften down, and, causing suppuration, escape externally by ulceration. From the inner surface of these evacuated cysts a new growth may spring up of a peculiar nature; and this, forming an irregular, fungating, bleeding surface, at times puts on an appearance which has been mistaken for cancer. On examining the edges of the wound, however, such a mistake can hardly be persisted in, for it will be at once observed that the edges of the wound are healthy and not infiltrated with new matter, as would be the case in cancer—this irregular fungating growth consisting of exuberant granulations from the cyst itself. Abernethy described these growths years ago, but in more modern times the best account is given by Mr. Cock, in 'Guy's Hosp. Reports,' 1852.

In other cases, again, a horny growth springs up from the interior of the cyst. I have removed one of twenty-one years' growth (Fig. 17, p. 90) from the head of a man æt. 70, upon which were wens of different sizes.

TREATMENT.—The only correct treatment of these cysts, whether whole or broken, is their removal by excision; and in doing this it is needless to be too careful to dissect the cyst out entire; the most expeditious method is to slip open the tumor with a bistoury, and turn it out with the forceps or handle of a knife. The plan is rapid and effective, and far superior to the older and unnecessary one of a steady dissection. In some cases of long standing, however, dissection is required. In children, the cysts may frequently be squeezed out of their bed by the thumb and finger.

It is common to hear of the danger of erysipelas after these excisions, but such a fear is groundless. The excision of the congenital tumor is sometimes difficult on account of its close attachments, and unless all the cyst is removed a return of the growth may be looked for. Some surgeons consequently advise the careful dissection of the cyst; I have generally found, however, a free incision into it, and the removal of its walls by the scalpel or scissors to be sufficient.

The scalp may likewise be the seat of other tumors, *simple* or *malignant*, of *epithelial* cancer of the skin, or of any other affection of the integument. These require no special attention here.

Nævi are very common in all their forms—cutaneous, subcutaneous, or mixed; but this subject will be considered in another chapter. Let me caution the student, however, not to adopt hastily any surgical proceedings with a nævus situated over a fontanelle, for although such may be dealt with with impunity I have known a fatal inflammation attack the membranes of the brain after the application of a ligature to an undoubtedly cutaneous nævus placed over this region. If possible he should wait till the bones have closed before he interferes.

Perforating tumors of the skull occasionally come under the surgeon's notice, and demand attention. The majority of them have their origin from the membranes covering the brain, and mainly from the dura mater. They are generally *cancerous*, and are often secondary deposits; though occasionally they seem to be of the "*fibroplastic*" nature. They were first described by Louis in 1744, under the term "fungus of the dura mater" ('Mém. de l'Acad. Roy. de Chir.,' tome v). Since his day all perforating tumors of the skull have been included under this heading. It must be remembered also that a tumor growing within the skull, and pressing outwards, will cause absorption of the cranial bones, and this fact is rendered familiar to pathologists by the enlargement of the Pacchionian bodies.

The symptoms indicating the presence of this affection are very uncertain, although headache, more or less constant and severe, may exist with epileptiform convulsions and other brain symptoms; yet, as often as not, the first marked condition to which the patient's attention is directed is a swelling in one of the bones, the disease having progressed thus far without having given rise to any symptoms whatever. When the diseased mass has perforated the bone the swelling receiving its impulse from the brain, will be pulsatile, and this symptom is of importance, as a distinctive one between tumors of the bone itself and the perforating tumors of the membranes. In cancerous disease the bone itself will be infiltrated with cancerous elements and destroyed, while in benign tumors the bone will be absorbed simply by pressure, as is seen in aneurism. In the former case the opening in the bone will be ill defined and irregular, and in the latter it will be smooth as well as regular.

With respect to treatment, it is almost needless to say that nothing can be done by way of removal of the growth. The symptoms to which it gives rise can only be relieved by sedatives, and life prolonged by general treatment.

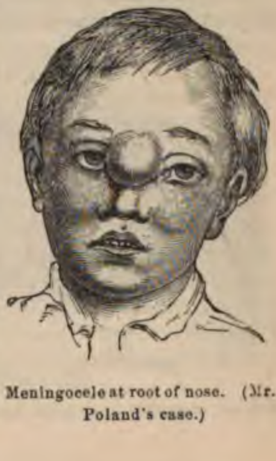
The bones of the skull are liable to tumors, cancerous or benign, to exostoses, particularly of the ivory kind, and to myeloid growths; though in this place it is only necessary to mention the fact.

Meningocele and Encephalocele.

These terms are applied to conditions of the head found in children at the time of birth, and infants thus affected are generally hydrocephalic. The words indicate a protrusion through the skull either of the membranes of the brain or of the brain itself; the protrusion appearing as an elastic tumor in the line of one of the sutures. Such cases are always associated with some deficiency of the bones of the skull, it may be of some portion of the frontal bone, near the root of the nose (Fig. 72) or near its external angular process, and by far the most frequently of the occipital bone. In rare examples the deficiency may be at the base of the skull. Dr. Lichtenberg has recorded a case in the 'Transactions of the Pathological Society,' vol. xviii, in which the tumor was hanging out of the child's mouth, and communicating with the skull through an opening in front of the sella turcica.

In a *meningocele* the membranes, may protrude as a whole; but sometimes the dura mater alone projects (*vide* Prep. 1563⁸⁰, Guy's Museum). In the true *encephalocele*, the brain itself is pressed out of the skull into the external tumor. This was well seen in a patient of Dr. Lever's, from whom the accompanying drawing (Fig. 73) was taken; the skull contained the anterior part of the middle lobes of the brain and

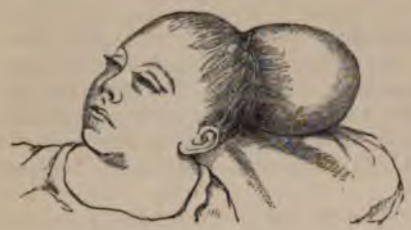
Fig. 72.



Meningocele at root of nose. (Mr. Poland's case.)

the sac the remaining portions. The ventricles were likewise divided between the two. The posterior lobes were adherent to the membranes that formed the sac. In a *hydrencephalocele*, in addition to the brain substance, there will be a portion of one or both of the ventricles filled with fluid.

FIG. 73.



Encephalocele.
(Drawing 501^{90}, Guy's Hosp. Mus.)

"An *encephalocele*," writes Mr. P. Hewett ('St. George's Hosp. Rep.,' vol. vi), "is of a round or oval shape; in size it seldom exceeds that of a small orange; its attachment is broad; the integuments covering it present little or no alteration. In the earlier periods it has the characteristics of a watery bag; but later on, as the fluid gradually disappears, the brain matter fills the sac, and then the tumor becomes soft and doughy."

A *hydrencephalocele* "in shape is more or less pyriform, with a marked contraction at its attachment, and sometimes a long and narrow stem; in size it is apt to become much larger than an encephalocele. The integuments over it are thinner, fluctuation exists about the hernia, and large veins may be traced under the skin."

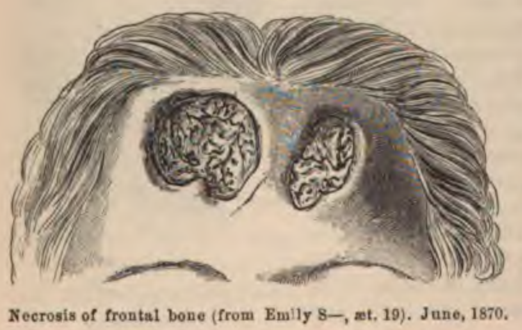
When these tumors are small and have a very minute communication with the cranial contents, they have been and may be again mistaken for some simple cyst or tumor. The surgeon should therefore always suspect that a cystic tumor, situated in the median line, over a fontanelle or suture and particularly when over the nose, may have some communication with the membranes, and he should consequently postpone all operative interference till the diagnosis is clear. As the bones ossify, the opening between the tumor and the cranial contents may close. The cyst, if small, may then be excised; if large it may be injected with iodine or Morton's iodo-glycerine solution. The utmost caution, however, must be employed in the treatment of these cases, and where uncertainty exists as to their true nature or attachments, the prudent surgeon had better leave the case to nature than risk life by any hazardous enterprise.

Ostitis and periostitis of the bones of the cranium are common affections and may occur either as a consequence of a local injury, of syphilis, or of other causes. They are also often associated with brain complications. Under the heading of traumatic encephalitis this subject was discussed, together with its treatment, and ostitis coming on from any cause other than injury presents very similar symptoms. I have seen in an infant periostitis the result of hereditary syphilis, and ostitis ending in necrosis. I have seen also half the frontal bone of a babe exfoliate after a punctured wound from a nail, without any brain symptoms. In the adult the complications attending inflammation of the bones, syphilitic or otherwise, are very variable.

The symptoms are generally local so long as the inflammation is confined to the periosteum covering in the bone, the chief being pain and tenderness, with local swelling; though when the inflammation has spread to the inner periosteum or dura mater, other symptoms appear; such as constant headache, and great irritability of brain; any worry or work increases pain, causes fever, restlessness, and want of sleep. As the disease progresses delirium, convulsions, paralysis, coma, and death may be the result.

The inflammation in the bone may go on to suppuration, or necrosis; the dead bone may exfoliate in masses (Fig. 74) or in small portions. Should no external outlet for the pus exist, it will press inwards and aggravate the brain symptoms; and, if no external vent to the suppuration be made, either by natural processes or by the surgeon, the retained pus within the skull may give rise to symptoms of compression of the brain, when it is probable that the brain itself and its serous membrane are also involved, and the case becomes a most serious one. It is, consequently, a point of great importance for the surgeon to anticipate such a complication, and, if possible, to prevent it, and this leads me to speak of the treatment of the affection.

FIG. 74.



Necrosis of frontal bone (from Emily S—, æt. 19). June, 1870.

When a patient has had a blow upon the head, or been the subject of syphilis, and as an after symptom a local swelling appears, or pain of a constant and wearying character, the suspicion should be excited of these symptoms being due to a local ostitis. When the swelling is tender to the touch, and pain is aggravated by local pressure, this suspicion should be strengthened; and when these conditions are attended by pyrexia more or less severe, sleeplessness, a quick irritable pulse, and a contracted pupil, a local inflammation of the bone may safely be diagnosed, the inflammation probably involving the dura mater within and the periosteum without. Under these circumstances a free incision down to the bone should be made, since experience has proved that by the adoption of this practice, pain and other symptoms are, as a rule, relieved, and serious brain complications are often prevented. When external suppuration with the exposure of dead or dying bone is present, it is less common to meet with cerebral symptoms, since the pus finds its way externally through the wound, and there is consequently less irritation and pressure on the dura mater, as well as less brain irritation. Should, however, brain complications appear, it is important for the surgeon to interfere, to prevent their spreading, as when confirmed brain symptoms have manifested themselves, the case is almost hopeless. The surgeon, under these circumstances, should attempt to remove the necrosed bone, or perforate it by the trephine—both these operations having one common object, viz., to give free vent to the pus beneath.

Trephining, under such circumstances, is not only a justifiable, but, probably, a valuable operation, and if performed with care, can do little harm. When operation is postponed till confirmed brain symptoms have appeared, there is too much reason to believe that irremediable changes have taken place, such as suppuration within the hemisphere or arachnitis, which no operation is likely to relieve. Trephining has, however, been of use even in such cases when complicated with epileptiform convulsions; but the surgeon should anticipate this stage of the disease when he can, and interfere before such symptoms appear; headache of a local and persistent character, associated with evident signs of local ostitis or necrosis, is always an indication of the propriety of trephining.

I need hardly add that constitutional treatment such as has been mentioned under the healing of encephalitis, and will be alluded to when the subject of syphilis is considered, ought to be carefully followed out.

M. Aran, 'Archives Générales de Médecine,' 1844.—*Cock*, 'Guy's Reports,' 1842.—*Hewett*, 'System of Surgery,' by Holmes, Sec. Ed., 1870.—*Le Gros Clark*, 'Lectures at Royal College of Surgeons,' 1869.—*Pott*, 'Injuries of the Head,' 1768.—*Guthrie*, 'Commentaries in Surgery,' 1853.—'Erichsen's Surgery,' 5th Ed., 1869.—Hutchinson's Prize Essay (Astley Cooper), 1865.—*Brodie* 'Med.-Chir. Trans.,' vol. xiv.—*Wilks and Moxon's* 'Lectures on Pathology.'—*Callender*, 'St. Bartholomew's Hosp. Reports,' vols. i. and iii.—*Hilton*, "Clinical Lectures," 'Lancet,' 1853.—*Nélaton*, Atlee's edition, 1855.—*Gama*, 'Traités des Plaies de Tête,' 1835.—*Adams*, 'Cooper's Surg. Dictionary,' 1861.—*J. Neudörfer*, M.D., Prague, 'Handbuch der Kriegschirurgie,' 1867.—*Pirogoff*, N. Leipzig, 1864.—Stromeyer's edition, of *W. MacCormac's* 'Notes of an Ambulance Surgeon,' 1871.

ON TRISMUS AND TETANUS.

When a patient is the subject of an uncontrollable spasmodic contraction of the muscles of the lower jaw, he is said to have "*trismus*" or lockjaw; and when the same condition attacks other or all the voluntary muscles of the body, he is said to have "*tetanus.*" Tetanus includes trismus, and generally begins with it; though trismus may be a local affection. It is found in children as a result of dentition, and in adults, as a consequence of diseases involving the teeth, gums, or jaws. It is a spasmodic affection, produced by reflected irritation set up by a local disease, is rarely associated with any constitutional disturbance, and is, for the most part, cured on the removal of its cause.

Tetanus is likewise generally associated with some local source of irritation, some wound or injury; and is then called "*traumatic.*" When no external or visible cause can be made out, it is denominated "*idiopathic.*" When rapid in its course, it is called "*acute;*" when slow, "*chronic.*" The acute form is usually the result of an accident, and generally fatal. The chronic is for the most part idiopathic, and more curable.

Tetanus nascentium.—Tetanus is met with in new-born infants, and is then known as *trismus nascentium*, or *tetanus infantum.* It usually comes on the second week after birth, and may be so acute in its course as to destroy life in from ten to thirty hours; or life may be prolonged to eight or nine days. It is a common affection in the West Indies, and has been known to occur frequently in ill-ventilated lying-in hospitals. Bad ventilation consequently has been put down as one of its causes, the others being cold, exposure, internal irritation, and the division of the umbilical cord.

Predisposing cases of tetanus.—Dismissing the last form of the disease from our consideration, it seems that tetanus may be found at any period of life, though more than half of the cases occur between ten and thirty years of age. The youngest case on record was in a child of twenty-two months, and the oldest in an adult of seventy-five years.

It is more common in males than in females, and the proportion is as seven to one. It is found in the healthy as frequently as in the cachectic, nor do the intemperate seem more prone to its attack than the temperate. It is, too, as frequent in the winter as in the summer months; though in warm climates the natives are more susceptible to its attack than Europeans. Exposure to damp, cold, or sudden changes of temperature, have doubtless a powerful influence in exciting this disease, both in the idiopathic and traumatic forms. Larrey stated that after a great battle, a hundred soldiers were found affected by it in one morning.

Exciting causes.—Tetanus is rare in the course of ordinary surgical disease, although it may follow any form of injury from the slightest contusion to the severest compound fracture. It may occur after the extraction of a tooth, or the gravest operation in surgery, and it is known in obstetric practice as *puerperal* tetanus. It is most common after the more severe varieties of accidents, such as burns, compound fractures, and injuries to the fingers and toes, though there is no evidence to prove that it is more frequent after slight injuries to the fingers and toes than to other parts. Lacerated seem to be more frequently followed by tetanus than incised wounds, particularly in children. The state of the wound does not appear to have any influence on the disease. Seven years' experience at Guy's Hospital gives the following facts (Poland):—

Tetanus	occurred in	1 case	out of	1394	cases of	major and minor operations.
"	"	9 cases	"	594	"	wounds of all varieties.
"	"	1 case	"	856	"	injuries and contusions.
"	"	3 cases	"	456	"	burns and scalds.
"	"	9 cases	"	398	"	compound fractures.
		23		3698 cases, or 1 in every 160 cases.		

There is no definite period at which tetanic symptoms are prone to appear. When they set in soon after the injury, they are for the most part acute and very fatal; after the lapse of three weeks, the chances of their appearance are very small. Acute cases, however, occasionally occur during the second week; upon this point Poland gives us the following facts:—

Of	277 cases,	130	began	before the 10th day, and of these 101 died.
"	"	126	"	between the 10th and 22d day, and of these 65 died.
"	"	21	"	after the 22d day, and of these 8 died.

In tetanus following exposure to cold the symptoms generally appear rapidly after the exciting cause, and with the same exciting cause, similar results occur in the traumatic form.

Symptoms.—There are no general or local premonitory symptoms by which the onset of this affection can be recognized, and the earliest indications of its approach are generally a difficulty in opening the mouth, with stiffness in the muscles of the lower jaw; yet these symptoms may be so slight as to pass unheeded, or to be misinterpreted. When, however, some rigidity of the muscles of the neck, throat, or abdomen can be made out, and the first indications of the "tetanic grin," or *risus sardonicus*, recognized—this symptom being caused by the drawing down of the corners of the mouth, by the muscles of the face—the diagnosis becomes certain. Difficulty in swallowing will then soon appear (any attempt to drink fluids exciting spasm of the muscles of deglutition and often of respiration), with pain, due to spasm of the diaphragm, shooting through the body from the scrobiculus cordis.

As the disease progresses the muscular system of the body generally will be more or less affected, and, in different cases, different groups of muscles will be involved. Those of the back are the most frequently attacked, and their contraction may be so powerful as to cause an arching backwards of the frame, producing what is known as *opisthotonos.* In rare cases, the body is bent laterally or forwards, the terms *pleurosthotonos* and *emprosthotonos* being respectively applied to such conditions.

The muscles of respiration are, as a rule, affected early in acute cases, and the chief danger to life consists in the severity of the spasms which attack them. When severe, the first spasm may be fatal, and may occur at an early or at a remote period of the affection. In a case under my care, of severe traumatic tetanus, all the symptoms were disappearing, and recovery was confidently expected; when, on the tenth day of the disease, the first spasm of the laryngeal muscles took place, which destroyed life.

When the jaw is unlocked by a spasm of the depressor muscles, the tongue is sometimes suddenly shot out from between the teeth, and often wounded.

As the disease advances the jaws become completely fixed, and deglutition is then impossible. The spasms of the muscles of the frame become more intense and frequent, and the powers of the patient rapidly decline. The pulse which was rapid, becomes more feeble, while the expression of the countenance betokens agony of the body and despair of the mind. The slightest manipulation or movement of the patient sets up a fresh spasm, and any emotion may do the same. The skin becomes bathed with a cold sweat, and, if death is not caused by suffocation, exhaustion soon puts an end to suffering.

There is rarely any fever during the whole course of the disease, the bowels are always costive, the stools offensive, and the urine, as a rule, natural.

The intellectual faculties of the patient almost always remain unimpaired throughout, while the senses are morbidly acute. Anything like delirium is rarely seen.

Should the case tend towards recovery, the spasms will become milder in character, and recur at longer intervals till they disappear. *It should be remembered, however, that, as long as the slightest evidence of disease exists, a sudden spasm of the glottis may at any time destroy life.*

Diagnosis.—This should not be a difficult task, and in every instance of lockjaw, the possibility of its being the commencement of tetanus ought to be entertained. Local irritations, however, such as have been previously alluded to, only produce a locking of the jaw more or less complete, and are never accompanied by uncontrollable spasm, as is the case in tetanus.

To diagnose between tetanus and poisoning by strychnine may be difficult, the symptoms of both being very similar, yet in tetanus the symptoms are progressive, while in poisoning they appear suddenly in all their severity. In tetanus, muscular rigidity is always present and aggravated at intervals; in poisoning there are complete intervals of relaxation of muscle. In tetanus, too, there is constant rigidity of the muscles of the jaw; in poisoning, the jaw is never locked except during the spasm. These points of difference are sufficient to assist the surgeon in the investigation of a doubtful case.

Again, hydrophobia and tetanus have been mistaken the one for the other, but any one who has the former disease could hardly fall into such an error. The peculiar restlessness of mind and body, the complete intervals of rest and absence of spasms, the peculiar aversion that is shown to fluid, accompanied by thirst, all symptoms characteristic of hydrophobia, are enough to distinguish between the two. Nevertheless, it should be remembered that Dr. J. W. Ogle, late of St. George's, has recorded a case of tetanus and hydrophobia combined. ('Brit. and For. Med. Rev.,' 1868.)

Prognosis.—In acute traumatic cases there are small hopes of recovery while in chronic the chances are greater. The longer the patient lives the better seem the prospects of a good result; and, if ten days pass after the first appearance of the symptoms, and the disease is on the decline, the prognosis is favorable.

Taking all cases together, Poland gives one recovery to seven and a half deaths. More than half die within five days. The most rapid death has been in from four to five hours; and the longest duration of life on record in a fatal case, is thirty-nine days.

How death is caused.—There can be little doubt that acute tetanus commonly destroys life by apnœa; spasm of the muscles of respiration and more particularly those of the larynx being the immediate cause. Poland tells us that this was the case in thirty-two out of forty-six cases at Guy's Hospital in which the mode of death was noticed.

In chronic tetanus, death is commonly caused by exhaustion. These facts have an important bearing on the treatment of the disease.

Pathology.—The late Mr. Wilkinson King, of Guy's, is stated by Poland to have been in the habit of remarking at the post-mortem table, whenever there was an examination of a case of death from tetanus, "Gentlemen, we will now proceed to give you a demonstration of a case of healthy anatomy, for there will be no visible morbid appearances otherwise than congestion of the organs in various degrees, owing to accidental circumstances." And at the present day these remarks hold good. It is true that Rokitansky, Demme, Lockhart Clarke, and Ditkinson, have given us some descriptions of structural changes in the spinal cord which they have observed; and their observations moreover seem to coincide. These changes consist of disintegration and softening of a portion of the gray substance of the cord, which appears in certain parts to be almost diffluent. The semi-fluid substance thus formed, however, "is at first more or less granular, holding in suspension the fragments and particles of the disintegrated tissue, but in many places it is perfectly pellucid" (L. Clarke). Yet it is to be remembered that Billroth and other pathologists have failed to find these changes in the instances which they have examined, and it cannot therefore be accepted as certain, that these pathological conditions are constant in tetanus. There can be little doubt, however, that the nerves of the injured part are at times found inflamed and irritated, and from this fact, the theory has been advanced, that through the injured nerves of the part the spinal centres become involved, and manifest these states of excitement through the motor nerves by producing muscular spasm; the disease being one essentially of the excito-motory system. Clarke believes "that the spasms of tetanus depend on the conjoined operation of two separate causes. First, that they depend on an abnormally excitable state of the gray nerve tissue of the cord induced by the hyperæmic and morbid state of its bloodvessels, with the exudations and disintegrations resulting therefrom. Secondly, that the spasms depend on the persistent irritation of the peripheral nerves, by which the exalted excitability of the cord is aroused."

TREATMENT.—Every imaginable form of treatment has been employed in this disease with success, to be discarded in its turn for something new. No settled form of practice can consequently be laid down. Still, much can be done in guiding the patient through this disease; in keeping him alive; and in warding off death.

To keep the patient alive the most careful attention to feeding is required; milk and concentrated liquid animal food being the best diet. If these can be taken in sufficient quantities, no other mode of administration is required; but if not, they must be given as enemata every four or six hours as the case demands. Stimulants must be used cautiously, though when the powers are failing they may be freely given.

Upon this principle of practice, quinine has been strongly recommended; it may be given in full doses to an adult, such as five grains every three or four hours, and then increased; or in one large dose such as twenty grains, to be followed by the smaller one.

Among specific remedies that have been greatly vaunted, the Calabar bean stands foremost, and may be given in full doses, such as half a grain of the extract every two or three hours. Camphor also recommends itself to our notice in doses of from five to ten grains. The woorara poison has failed in its purpose. The bromide of ammonium or potassium has, however, been administered with advantage.

It was hoped that a valuable drug for this disease had been found in chloroform, but experience has not justified the expectation. The hydrate of chloral has now taken its place and been of some service. Demme has advocated with much success the use of the Curara, eight cases out of twenty-two having recovered under such treatment. In India the Indian hemp has been highly recommended. Nicotine and tobacco have also been successful. Aconite is another drug that offers some advantages, while opium has an unquestionable influence in allaying pain and mitigating the severity of the spasm. Ice also, applied in bags along the spine, has apparently been of great value in the hands of American surgeons. The administration of remedies by subcutaneous injection, in these cases, promises to be a valuable adjunct to practice, enabling us rapidly to introduce into the system drugs that act antagonistically to tetanic spasm.

The patient should always be kept quiet, warm, and free from draught. He should, moreover, be so watched that in his spasms no injury can be sustained; attention should be paid to his bladder and bowels, for catheterism is sometimes called for; and purgatives or enemata to clear out the intestines are beneficial, although violent purgation cannot be advised.

With respect to *local treatment* much may sometimes be done. In severe local injury when the nerves of the part are probably involved, amputation ought certainly to be performed; for a sufficient number of cases have been recorded in which success followed the practice. In 1845 Mr. Key amputated a leg on account of tetanus, which had appeared six days after an unreduced dislocation of the astragalus; the symptoms disappeared at once after the operation. On dissecting the foot the posterior tibial nerve was found to have been put violently on the stretch by the projecting astragalus.

In some cases, soothing applications, such as opium, may be applied to the wound, and in all, perfect cleanliness should be enforced.

One other means of cure remains to be noticed, which has reference to the mode o death in this disease. It has been shown that in the larger proportion of cases—in al the acute—death is caused by suffocation from spasm of the laryngeal muscles. It is also fairly recognized that this disease runs its course, and that the most our science can accomplish is to maintain life and ward off death. To this end the operation of tracheotomy seems to be of value, for with a tube in the trachea, death by laryngeal spasm cannot take place, and a better prospect of recovery is consequently given.

I have employed this practice in one acute case, in which the Calabar bean was like wise given, and the patient sank from exhaustion, free from spasm; and there seems good reason to believe, that if I had performed the operation in the case I recorded in the early part of this chapter, life would have been saved. The matter, however, requires grave consideration, and the practice is not to be rashly followed.

Morgan, 'On Tetanus,' 1833.—*Curling*, 'On Tetanus.'—*Poland*, 'Guy's Hospital Reports,' 1857.—*Dr. Ogle*, 'Brit. and For. Med. Review,' 1868.—*Dr. Dickson*, 'Med.-Chir. Trans.', vol. vii.—*Dr. L. Clarke*, Ibid., vol. xlviii.—*Dr. Dickinson*, Ibid., vol. li.—*Demme*, 'Schmidt's Jahrb.,' vol. 112.—*Thamhayn, O.*, Ibid.—'Year-Book,' Sydenham Society,' 1862–64, &c.—"Puerperal Tetanus," 'Dublin Quart. Journ.,' 1865; 'Med. Times and Gaz.,' 1865.—*Billroth*, 'Pathol. Chirurg.,' 1868.

DELIRIUM TREMENS.

It often falls to the surgeon to treat cases of pure delirium tremens uncomplicated with any surgical malady, and it is well, therefore, to refer to this subject by itself. There are other cases, perhaps, more aptly described by the term "*traumatic delirium*," in which the nervous symptoms are developed as a consequence of an injury received. In both classes the symptoms are essentially the same, and the treatment required is similar, still it is right to bear in mind the difference in causation, as in the one we have to deal with a nervous disease in an intemperate person, and in the other, with the same symptoms as an incident in a surgical case. In simple delirium tremens, to use the familiar term, we have to deal with the case of a person who has indulged for an uncertain time in injurious doses of alcoholic liquors. It may be that a young man, after a prolonged debauch, has an attack of the "horrors," but the symptoms more frequently occur in those who have for a long period accustomed themselves to the excessive use of beer or spirits, even without amounting to drunkenness, and who at length are subjected to some shock or depressing influence. Inasmuch as the habits which have been mentioned as superinducing this disease are opposed to the simplest laws of health, it follows that they cannot be indulged in with impunity for long, and, consequently, we find the subjects of it, as a rule, of feeble powers of resistance, and often with diseased viscera. Such persons are bad subjects for any ailment, and it often happens, that when a person of this sort breaks his leg or meets with some injury requiring surgical treatment, he becomes the subject of delirium tremens. Other causes are occasionally at work, such as starvation, mental anxiety, and the overuse of tobacco or opium.

The disease is at times ushered in by certain premonitory symptoms, as patients who have once been the subject of an attack are sometimes conscious of the approach of another. A brewer who had been treated for this affection at Guy's some years ago, when he felt warnings of its advance, on several occasions subsequently applied for admission, and, as a result, the attack was warded off.

Depression of mind and body are the chief premonitory symptoms, with restlessness and agitation, gloom and foreboding of evil. Some slight febrile disturbance may also exist, but the one invariable and most important symptom is sleeplessness. The tongue is generally pale and flabby, as well as coated with a whitish fur, and is never dry. The appetite is bad, the breath often fetid, and the bowels confined. The pulse may be quick, though soft and powerless. The skin is always moist, and at times bathed in perspiration. With these symptoms the characteristic delirium with trembling is not far off. It may, however, in surgical practice set in suddenly without warning. The nature of the delirium is very characteristic, and is always accompanied by illusions which are generally spectral. The patient sees objects that do not exist, and hears sounds that are imaginary; these being always of a strange or frightful nature. At times some delusion as to business or home matters agitates the mind. These same unsound ideas are sometimes fixed during the whole attack; but more commonly succeed one another in rapid rotation. Sleeplessness under these circumstances is a constant accompaniment. The patient will be quiet for a time, muttering words without meaning, or, he will be restless and get out of bed in obedience to some imaginary call. He will pull about his bedclothes, will rise up in bed at one moment under one impression, and lie down again under another. If asked to put out his tongue he will do so, but probably with a jerk; if to give his hand, he will project it with a thrust. A nervous trembling of the extremities, with an utter want of control or steadiness of purpose is characteristic. If these symptoms continue, and rest cannot be obtained, prostration of all the powers will rapidly appear, and death supervene from exhaustion or coma. If sleep—sound sleep—can be secured, the symptoms usually mitigate rapidly.

The *prognosis* must depend on several considerations. If the patient be young and the attack ensue after a short period of drinking, the chances of recovery are hopeful, but if the attack occur in a man of middle age, habituated to over-drinking, and if his liver or kidneys be unsound, it is fraught with much greater danger. If the attack be associated, moreover, with an injury, such as a wound or fracture, another element of danger is introduced. The best guide to the patient's real condition is the study of the pulse, not merely as to the number of its beats, but with regard to its character. The sphygmograph is of great service in such cases, as by its help a "dicrotic" state of pulse is often shown where the finger would not indicate it, and such a condition is a bad omen. The most frequent complication is pneumonia, which often comes on rapidly and insidiously, and is a frequent cause of speedy death even when the excitement has subsided.

TREATMENT.—This disease essentially being one of depression of the nervous system associated with sleeplessness, the main object of the surgeon is to induce sleep, to calm the excited brain, and to give it time to recover its normal functions; and with this end, absolute quiet and the use of bland and nutritious food are most essential.

Easily digested, nutritious food must be administered when it can be taken by the mouth, but when refused or rejected, resort must be had to enemata. Milk is, undoubtedly, the most suitable form of nourishment, either alone or mixed with eggs, but it does not suit all stomachs. The question of giving stimulants, and to what extent, is one of great importance. As a rule, the less given, the better, but in some cases it is advisable to give them, and that form of alcohol to which the patient has been accustomed is the best. Young men with an acute attack may do well without any, but in other cases, the feeble powers of the patient require some such aid to stand against the exhaustion caused by the restlessness and excitement. The chief reliance, however, should be placed on other forms of food, such as strong animal broths, Darby's fluid meat, or similar preparations.

Opium, in one of its forms, is a drug still in favor, although some reject its use altogether, and trust to feeding and time; relying upon the knowledge, that the disease has a natural tendency to terminate in sleep after the second or third day. In an ordinary case of the disease, one grain may be given as a dose, or ♏xx of the tincture, repeated every three or four hours or oftener, till sleep is procured. In other cases two or three grains may be given at once, and followed by grain or half-grain doses.

The best method of administering drugs in this disease, however, is by subcutaneous injection, and I recommend the injection of morphia in solution in doses of a quarter or half a grain in preference to any other plan; because the condition of the stomach of patients suffering from the disease is far from satisfactory either for absorption or assimilation, and, by the hypodermic method of introducing the narcotic into the system, its absorption is more certain and rapid. In some cases the beneficial influence of morphia thus employed is very remarkable, and only in exceptional instances the treatment fails.

The use of chloroform has also been urged, though such a plan is not devoid of danger and can hardly be advised except for some temporary purpose, such as to dress a wound, or to enable an enema to be given. The hydrate of chloral is a drug of great value as possessing hypnotic qualities without the evils attendant on other drugs of this class. It may be given in doses of 20 to 40 grains, and repeated, at moderate intervals, till sleep is procured. Drs. Kinnear and Lawson in the Melville Hospital have treated from 70 to 80 cases successfully with large doses of cayenne pepper, from 20 to 80 grains having been given as a dose. Dr. Maclean, of Netley, trusts to quiet and the use, at short intervals, of strong beef tea highly charged with cayenne pepper.

Of late years the value of digitalis has been greatly extolled, but my experience of it has not been favorable. It is given in large if not poisonous doses; two drachms of the tincture every hour for three or four doses till sleep is produced. It is a dangerous mode of treatment, and cannot be recommended.

When great excitement and some fever exist, antimony in small doses has been much advocated. The condition of the bowels almost always demands attention, as the tongue is usually foul and the secretions morbid. A purge sufficient to empty the colon is consequently of service, but violent purgation is injurious.

Tonics such as quinine and iron, with or without opium, will be required as the disease subsides. The combination of the tincture of iron with the tincture of opium in carefully regulated doses is preferable. In other cases ammonia with bark may be administered.

With respect to coercive measures in the treatment of these cases, there is no doubt that they ought to be condemned. In exceptional instances, where sufficient help cannot be obtained to prevent the patient from injuring himself or others, the jacket doubtless must be employed, but under no other circumstances is it justifiable. An attendant who combines decision of character and firmness, with a gentle and soothing manner, will almost always succeed in "influencing" the most troublesome patient. He is to *influence* him, however, and not to direct him; for contradiction and the exercise of authority over the subjects of this disease invariably excite opposition.

There are some people who are never drunk, yet are always drinking; in whom the tissues are so weak that under injury they rapidly break up; and under disease show no power of repair. In such it is difficult to induce wounds to heal or show any vigorous action.

The best remedy is to supply such patients with all sorts of nutritious food, to give tonics and a moderate amount of stimulants, and thus endeavor to improve their habits as well as restore them to a more healthy tone.

SHOCK AND COLLAPSE.

A man receiving unexpectedly some startling news, which excites severe emotion, and dying suddenly, is said to die from shock; a second receives a fatal blow upon the epigastrium; a third is struck dead by lightning; death in each case is said to be due to shock. In all, the heart's action is suddenly arrested through the nerve centres—in one case through the mind, and in the others through the body. Under these circumstances, the heart is found full of blood, distension having paralyzed its action.

A man receives a severe compound fracture, gunshot or other injury, and is not killed but collapsed. Another, or possibly a child, is much burned or has a large portion of the integuments of a limb torn away or crushed, in which the peripheral nerves are seriously involved, and, as a result reflex paralysis of the heart occurs. Both have sustained a shock more or less intense, and, as a consequence, become cold and almost, if not quite, pulseless. In either case, the skin appears to be bloodless, and covered with a cold clammy sweat. He may breathe almost imperceptibly, feebly, or with sighs and gasps. His nostrils will, probably, be dilated; his eyes dull, with vision imperfect; and consciousness may be lost in very variable degrees,—the patient may possibly be roused, yet, as a rule he requires rousing to prove the existence of consciousness. At other times, the intellect remains quite clear.

These are briefly the signs of collapse, or shock, the result of injury. They are to be found in variable degrees after most accidents, and are by no means usually fatal, unless the injury itself is fatal. Of course, if the shock from the injury is very great, the heart may cease to beat and the lungs to breathe, collapse passing, more or less slowly, into death; but more usually, after a variable period, the heart's action gradually improves, the respiratory act becomes more regular, and perfect color returns to the bloodless lips and skin, warmth re-appears on the surface of the body, and consciousness becomes more manifest; these symptoms indicate what is known as reaction, and, when they are excessive febrile symptoms may appear. It should be noted, that vomiting is often the first indication of reaction in general collapse, as it is often in that of head injuries. Should the nature of the accident be such that hemorrhage complicates the case, the collapse will be more lasting, the shock of the accident passing into collapse from hemorrhage; under such circumstances a fatal result is very likely to ensue (the amount of bleeding and its rapidity determining the result), for it should be known, that hemorrhage by itself is enough to produce collapse, or syncope, and this, added to the shock of the injury, is often more than enough to destroy life. In abdominal injuries, this combination is well seen, the hemorrhage from a lacerated liver or other organ, as a rule, appearing with the first manifestations of reaction from the shock of the accident, and thereby proving fatal.

The longer the reaction is delayed, the more grave is the aspect of the case; not unfrequently relapses appear, signs of reaction and of collapse alternating in variable degree, till one or the other asserts itself in recovery or in death.

In rare cases, even from the shock of a slight accident, reaction is followed by exceptional symptoms; thus, I had a man under care who was admitted with a slight concussion of the brain, in whom reaction was attended with an acute attack of maniacal exeitement which left him after two days to pass on to a steady convalescence. A woman with a similar injury attended with a scalp wound, had a like attack, which lasted a fortnight and then subsided without any bad results. I have recorded also, in another page, a case of general tetanic spasm which showed itself in the reaction after a case of spinal injury. More commonly, however, reaction is attended with what Travers has described as "prostration with excitement," a state bordering on, and often passing into, that known as delirium tremens.

Under some conditions of the system shock and collapse are more readily produced than at others; thus, very young and very old subjects, those enfeebled from age or other cause, mental or physical, are particularly apt to die of shock, after injury or operation. When bones are involved in the injury and symptoms of "shock" appear after a day or two's satisfactory progress, Professor Nussbaum believes them to be due to fat embolism as evidenced by severe dyspnœa, œdema of lungs, and sudden death. Patients with bad kidneys, also, are very liable to suffer from shock, and to succumb to any operation, however trivial. Surgeons see this at times in the sinking after small operations. Thus, I lost some years ago, after the removal of a fatty tumor, a woman of middle age, simply from asthenia; the operation having been unattended by any loss of blood; also a child, æt. 8, after some operation on a cicatrix of the neck, in the same way. In both, bad kidneys were found after death. The idiosyncrasy of the individual has also a powerful influence on "shock."

TREATMENT.—Shock or collapse uncomplicated with hemorrhage may be treated in one way; shock or collapse, the consequence of, or combined with hemorrhage, in another.

In both cases the heart's action must be either excited or maintained; "the heart must beat, and the patient must breathe," or life will fall. Even in the worst cases, as long as any signs of life exist, the respiratory process may be aided by artificial respiration, and the warmth of the body kept up by external applications. Savory, in an able article ('Holmes's System,' Ed. 2, vol. i), advises as the result of experiment and reasoning that, should no evidence of the heart's action be detected, and no hemorrhage complicate the case, a vein should be opened—as the external jugular—in order that the over-distended heart may resume its action as soon as it is relieved from its paralysis by distension.

In the extreme collapse following hemorrhage transfusion is also "a fair and rational expedient."

In less severe examples the surgeon's object should be to keep the patient alive, but he ought not to try to do more; as to force nature is always injurious, and sometimes fatal. The failing powers of a feeble subject may be excited to act only to give way again, they may not a second time respond to the former stimulant.

A too rapid reaction may so stimulate the heart as to set up a fatal hemorrhage, when, by the collapse, the wounded artery might have become sealed by nature's own blood-clot.

In all cases of shock and collapse, therefore, complicated with local injury, great judgment is called for. To do enough to maintain life is essential, but to do more is injurious.

The horizontal position under all circumstances should be observed, and external warmth secured by means of blankets, and hot flannels applied to the pit of the stomach. Sir J. Simpson's plan of applying heat to the body is very beneficial, by filling six or eight soda-water bottles with boiling water and tightly corking them, and then drawing over each a woollen stocking wrung out of hot water. The bottles so covered, were then packed around the patient in bed. Stimulants in carefully adjusted quantities may be given, and brandy is the best. This should be given in small quantities, and if the heart's action fail to respond to its administration after two ounces or so have been swallowed, more is of little service, the stomach usually rejecting it. When the stomach rejects brandy, or the patient cannot swallow, an enema of brandy in warm starch, milk, or gruel, sometimes acts very rapidly. As soon as the heart's action is established, liquid food, such as warm milk, may be given, though only in small quantities, and the case should be carefully watched; food and stimulants should be given with discretion and as the symptoms indicate, the greater the loss of blood the greater being the necessity for food.

Excess of reaction is to be checked by soothing remedies, opium in any of its forms, henbane, and chloral, are also very valuable, a few hours' calm sleep generally acting like a charm, yet when brain complication appears this treatment is to be adopted with care. Anything like coma contra-indicates it.

In compound fractures and other local injuries demanding operation, it is an important question to decide, as to the wisdom of operating on a patient in a state of shock. Can the operation act as a stimulant, and tend to rouse him? or may it act as a second shock, and tend the other way? When the shock is severe, and the patient almost pulseless, it is doubtless the wiser plan to postpone all operative interference till the heart's action is re-established. To amputate a limb under extreme collapse is to destroy what chance of life exists, or to do an unnecessary operation. To amputate when reaction has set in after the lapse of a few hours, when external warmth, stimulants, and tonics have had their influence, is likely to prove successful.

In less severe examples of collapse, however, the same practice does not seem to be necessary, especially when hemorrhage has been the partial cause, and is still continuing, because when collapse is present, the loss of very little extra blood by oozing forbids any hope of a good reaction being established, and thus no benefit can be acquired by delay, but only harm. The administration of chloroform has, moreover, a stimulating influence upon the heart and nervous system, which is often very valuable. I have frequently performed primary amputation upon subjects in a state of partial collapse after injury under these circumstances, and have never regretted it. With a patient in a state of collapse no amputation should, however, be performed, when, by delay, no harm can accrue. When hemorrhage, however trivial, is going on, or is likely to recur at any moment, the surgeon should interfere and remove the part when its removal is essential.

When the collapse is associated with semi-consciousness, chloroform is not needed, the operation itself acting as a sufficient stimulant; but when the mind is clear as to what is going on, its use should not be withheld, because although it is true its secondary effects are sometimes depressing, and may be injurious, in a general way it has a beneficial influence, tending to prevent a second shock, both mentally and physically.

When extreme collapse exists.—"How far," writes Savory, "the patient should be allowed to rally, and when he has reached that state which will enable him to bear the operation, are, of course, questions which cannot be answered in a general manner, but which must be decided by the surgeon in each case."

Where the surgeon is in doubt about acting, he had better decide in favor of delay. When no doubt exists as to the wisdom of removing an injured part, and by delay harm must or may probably ensue, he should act at once, even when the patient has not quite rallied from the shock of the injury. When, so far as the local injury is concerned, the delay of a few days or hours is unimportant, all operative interference should be postponed.

In severe compound fractures, gunshot or otherwise, hemorrhage is almost sure to occur as soon as reaction appears, and the shock of the removal of a limb is not so much to be dreaded as the loss of blood. "Wounds of the large arteries of the legs and arms from balls and shells always bleed more or less at the time of reception, and more freely as the shock to the nervous system passes off and reaction comes on. Even when this nervous shock is not sufficient to produce immediate death, the chances of ultimate recovery must frequently turn on the mere question of loss of blood." (Hammond, U. S.)

In military practice, primary amputation upon the field is now generally preferred to secondary, and, in civil practice, a like rule should generally be enforced.

To perform any capital operation on a patient in a condition of extreme collapse or shock is bad practice. To do so, however, when a minor degree exists, and the pulse can be felt, when, by delay, other dangers are to be expected such as continued or renewed hemorrhage, is sound and good surgery. To an unconscious or only slightly conscious patient, chloroform is not necessary. To the conscious it has often a beneficial action, and tends towards the encouragement of reaction.

FEIGNED AND HYSTERICAL OR MIMICKED DISEASE.

I have placed these two classes of cases together for purposes of convenience, and in this section as they are essentially diseases of the nervous system. Both, in a measure, and with different degrees of accuracy, simulate real or organic disease, while feigned disease is a deception, and hysterical a reality. In the *former* the will of the patient is strong to deceive, it is bent to simulate the symptoms of an affection of which the individual knows something, though not all, and from this, the full knowledge of the surgeon or physician is to override the imperfect knowledge of the impostor and to expose him. In the *latter* the will of the patient is weak; functional derangement is allowed to assume the garb of organic disease; subjective symptoms are intensified, not, however, from motives of deception, but from a want of the controlling influence of health, more particularly of the nervous centres, a condition of hyperæsthesia commonly existing from some imperfect nutrition of the nervous centres. In exceptional cases anæsthesia is present, more particularly in the larynx.

Feigned disease is a voluntary deception from beginning to end, and is unreal. Hysterical disease is an involuntary exaggeration of some functional derangement, "an unwilling imitation of organic disease," and real.

Feigned affections are met with chiefly in the intellectually weak, or those of crafty character, and, in a general point of view are attended with an exaggeration of symptoms far beyond those met with in real or organic disease; pain is said to be far more intense than is usually met with, and paralysis more complete; every symptom simulated is extreme; inconsistencies are present which are not reconcilable with those symptoms usually met with in the disease simulated, and these inconsistencies and exaggerations should always excite suspicion in the mind of the practitioner, causing him to test quietly every symptom or group of symptoms, and to doubt his diagnosis until he has proved the truth. To the *subjective* symptoms, or those complained of by the patient, these remarks are very applicable; but to the *objective*, or those palpable to the observer, they are so to a degree. The subjective symptoms are always exaggerated, the objective inconsistent; the former being too bad for truth, the latter inconsistent with experience. For example, the rigor of an ague may be simulated, while the hot and the sweating stage is impossible. Epileptic convulsions, catalepsy, or madness, may undoubtedly be imitated; but in all these, there will be, when present, some exaggeration or inconsistency not found in the real disease. Paralysis can also be readily simulated, but it will, probably, be too complete; it will, on testing, more particularly when done unexpectedly, be associated with a greater degree of sensibility in the skin than is usually present. When of long standing it will not be attended with the usual wasting. Vomiting, coughing, or spitting of blood can be artificially produced, though under these circumstances the severity of the symptom will, probably, contrast strangely with the mildness of any others with which it may be attended.

In fact, in feigned diseases, on a careful investigation into the history of the case, the succession of symptoms, their progress, intensity, and duration, some element will be brought out which is irreconcilable with truth, some suspicion that deception is at work will be excited, which, if worked out, must unmask the imposture and prevent error.

The subjects of *hysterical disease or of nervous mimicry* are mostly what is called nervous and emotional. They have commonly "a very unusual mental character: in the majority, there is something, notably, good or bad, higher or lower, than the average—something outstanding or sunken."—Paget. In this affection "every part of the body may become, under provocation, the seat of an apparent disease that in reality does not exist; it may, and often does, assume all the attributes of reality with an exactness of imitation which nothing short of careful and accurate diagnosis can distinguish from the real disease."—Skey. In joint and spinal disease, the truth of this is most frequently seen, Brodie having stated "that among the higher classes of society at least four-fifths of the female patients who are commonly supposed to labor under diseases of the joints labor under hysteria."

How, then, it may well be asked, is the hysterical affection to be made out from the real? How is the surgeon to avoid falling into the error of treating some functional derangement as organic disease?

In a general sense, it may with truth be laid down, that in hysterical affection of a part, local pain and sensitiveness on manipulation, are always great, and bear no relation to the amount of changes visible or to be detected in the part. The slightest touch excites pain, which probably a bold one fails to do; the pain too rarely, if ever, follows the anatomical course of any nerve or nerves, and the onset of the symptoms is generally more sudden and severe than that usually ushering in organic affections. Febrile disturbance or increase of temperature, moreover, rarely complicates the case however severe the local symptoms may be, and the nervous "disturbance very rarely takes the form in which morbid nervous influence produces, not mimic, but real organic changes."—Paget. In fact, all the subjective symptoms are much more severe than the objective, the latter being either very slightly marked or non-existing. For example, a girl is suddenly seized with severe and lasting pain in the hip, knee, or other joint, aggravated by movement or the slightest touch, and yet no visible alteration in its outline or structure can be detected, even after the lapse of many months. Another is as suddenly affected with spinal affection, as indicated by local pain in the back, inability to stand, &c. &c., without any local evidence of organic disease. A third suddenly finds herself unable to flex or extend a limb, and the slightest force excites severe muscular spasm and pain. A fourth is attacked, without a cause, with some muscular spasm, possibly involving a finger or fingers—a spasm that resists all attempts at extension. A fifth suddenly loses sensation or the power of motion in some part of a limb, quite irrespective of nerve supply. In these cases, again, however severe the pain may be during the day, it is rarely felt at night. Such patients, as a rule, sleep well and quietly. During sleep, also, it often happens that joints which are immovable by day are found to be more flexed or extended. Patients with supposed diseased spine are found on their sides coiled up in a natural attitude. As an aid to diagnosis, the value of some anæsthetic cannot be too highly praised, as with a patient under its influence, rigid parts rapidly yield, rigidity of muscle returning only with consciousness, and those parts supposed to be paralyzed often move, suspected joint disease disappearing by a close examination where previously doubt existed.

Hysterical disease is more commonly met with in female than in male subjects, in single than in married, in those whose nervous systems have been unstrung from some mental or physical trial, or where the emotional centres are inadequately balanced by the higher controlling ganglia. It is characterized by the suddenness of its attack and the severity of all its subjective symptoms, neither the clinical history of the case nor the objective symptoms present being consistent with those usually met with in organic disease; the exaggeration of certain symptoms and the absence of others, coupled with the anomalies of its nature, mark the hysterical affection over the organic, and are sufficient to excite a doubt as to the true nature of the affection.

For valuable information on this subject, the reader may be referred to the lectures of Brodie, Skey, and Paget, Russell Reynolds's Essay on hysteria, and Anstie's lectures in 'Lancet.'

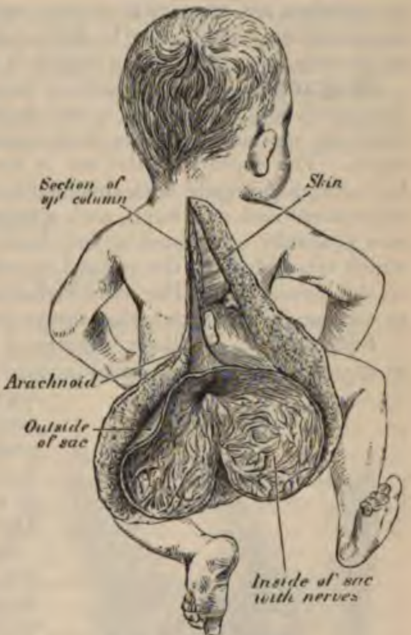
CHAPTER VII.

INJURIES AND DISEASES OF THE SPINE, &c.

SPINA BIFIDA.

A SPINA BIFIDA is essentially a hernia of the membranes of the cord through an opening in the spine, due to a congenital deficiency, from arrest of development, in some portion of the bones forming the spinal column. It is analogous to the meningoceles of the cranium which have been already described. It always contains subarachnoid fluid, and often the spinal cord itself, or, large nerve trunks. Mr. Hewett believes, that when the fluid has collected in the subarachnoid space, or between the cord and the membranes, the cord is pressed; and that when fluid alone is present, the collection is situated in the cavity of the arachnoid. Mr. Hutchinson has recorded ('Path. Trans.,' vol. viii) a case in which the serous sac in the cauda equina had a direct tubular communication with the cerebral ventricles; and in the specimen here figured (Fig. 75), taken from a dissection kindly made for me by Dr. Pye Smith, there was a funnel-shaped opening, leading from the tumor into the persistent central canal of the cord, the nerves being spread out under the internal lining of the sac, and thus forming one of the layers of its wall.

FIG. 75.



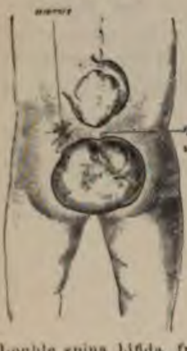
Dissection of spina bifida.

The spinal hernia is sometimes covered by the whole thickness of integument; at others, the integument, though present, is very thin; while occasionally the walls are represented only by a transparent membrane. This last condition was present in ten out of twenty-seven consecutive cases that have fallen under my care. The tumor may have a broad base and free communication with the spinal canal, or a narrow and more or less pedunculated one. Under the former circumstances, the probabilities of the cord being directly involved are greater than under the latter. The tumor is always more or less globular, tense, and elastic. When the child is asleep or quiet, the swelling may be soft; but when the child cries, the tumor will rapidly fill out. The edges of the bony orifice are occasionally to be felt.

The integument is, in some instances, ulcerated even at birth; while in others there will be a small opening in the walls, through which the serous spinal fluid exudes. A nævus is by no means rarely found situated over the tumor.

The tumor is often associated with hydrocephalus, and in exceptional instances is double (Fig. 76). Such complications as club-foot or paralysis of the lower limbs, frequently coexist with it, and under such circumstances, it is tolerably certain that the cord is included in the hernia; possibly the nature of the deformity may have been determined by the special nerves which are involved. Paralytic symptoms are more common in the broad-based hernia than in the narrow. Incontinence of urine or of feces may coexist with the paralysis, or be independent of it.

Fig. 76.



Double spina bifida, from Eliza F—, æt. 3 months.

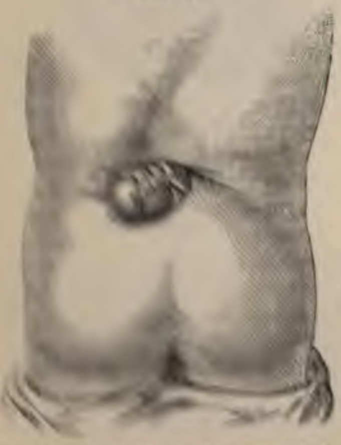
The lumbo-sacral portion of the column is more frequently affected than any other; but the cervical, and dorsal, portions are also liable to the defect. Thus, in twenty-seven examples which came consecutively under my care, thirteen occurred in the lumbar region, four in the lumbo-sacral, and nine in the sacral. One was double, a small tumor being in the lumbar and a large one in the sacral region (Fig. 76). Twelve of these cases were uncomplicated with any paralysis or deformity. In eleven there was incontinence of urine and feces, associated in four with paralysis of the lower extremities. Four were complicated with hydrocephalus, two with nævus, and one with talipes. I have seen but two examples in which the tumor was in the cervical region. When the tumor is complicated with hydrocephalus, fluctuation may often be felt between the two parts, pressure on the head causing a fulness of the spinal hernia, and, *vice versâ*. In exceptional cases, the spinal hernia may protrude on the anterior part of the spine.

Diagnosis.—In a general way there is no difficulty in diagnosing a spina bifida. In any infant a congenital tumor over the spine is probably a spina bifida; if globular and tense, or capable of becoming tense when the child cries, the probabilities are almost converted into a certainty, inasmuch as the only cases for which this affection is liable to be mistaken are congenital tumors unconnected with the spine—cystic, fibrous, fatty, or fœtal tumors. These may be hard and tense, but they are rarely, if ever, made so much more tense from the child crying as is the spinal hernia.

Prognosis.—The majority of these cases prove fatal. Many of the subjects are ill-developed, and die within a few days of birth; death from convulsions is very usual when the sac bursts and its fluid contents escape, more particularly when the escape is rapid. The rupture of the sac is not, however, necessarily followed by this result. I have watched a child with this affection for four years, in which at birth the tumor was transparent and soon burst, and, although it discharged at intervals for three years, it has now gradually contracted up into a solid mass. This case is an example of a natural cure, which takes place by the gradual approximation of the bony walls and closure of the orifice of the hernial sac. The more pedunculated the tumor, the better the prognosis, so long as no complication exists that threatens life.

TREATMENT.—Palliative treatment is all that can be adopted in the majority, although in exceptional instances operative interference promises to be of service. The tumor must always be guarded from injury by some soft protective material, such as cotton-wool or spongio-piline. Slight pressure sufficient to prevent rapid increase of the tumor is also beneficial, and the best method of applying it is, by a casing of gutta-percha or felt, moulded to the part. The application of collodion is sometimes useful.

Fig. 77.



Cured spina bifida, taken from man æt. 26.

Successful cases are recorded in which tapping of the hernia has been performed. The practice, however, is dangerous, as the drawing off of the fluid has been followed by convulsions and even death. Nevertheless, it is the least formidable form of practice that can be undertaken, and should always be employed before more active treatment is resorted to, if only as a preliminary measure. The puncture should always be made at the side of the tumor, for the cord when present is probably placed in the median line. The whole of the fluid should never be drawn off.

Fig. 77 represents a case cured by puncture. It occurred in the person of a man, æt. 26, who came under my care at Guy's Hospital in 1874, for some ulceration of his left foot, which, with the left lower extremity, was wasted from infantile paralysis. He had also a lateral curvature of the spine towards the right side, and a cured spina bifida in the lumbar region. I discovered from the patient that he had been treated for the spina bifida by Mr. W. E. Image, of Bury St. Edmund's, who, in answer to a note, kindly sent me the following account of the case.

"The child was brought to me when about two years old, because the tumor was increasing in size and convulsions were produced whenever any pressure was applied to the tumor, even from the weight of the body when placed in the supine position. The tumor was large and semi-transparent. I punctured it obliquely with a darning needle at intervals of two or three days, four or six times, and applied a compress of lint by means of strapping over the tumor. After this the fluid was not again secreted, the convulsions ceased, and the case got well." At the present time, a hard puckered tumor alone exists to indicate the affection. A model of the case may now be found in Guy's Museum.

Mr. Holmes speaks somewhat favorably of the practice by injection, and believes it to be often harmless. When performed, the fluid should only be partially withdrawn, and four or five drops of the tincture of iodine diluted with a drachm of water injected. The strength of the injection may be increased on each occasion, the object being to excite a slow process of inflammation in the cyst. In no case where the base or neck of the tumor is large, nor in others in which it is evident the cord is implicated, or large nerve trunks are involved, should this or any other operation be performed. In pedunculated tumors it may be attempted.

Dr. Ross Watt, of Ayr, N. B., has recorded ('Brit. Med. Journ.,' April, 1873, Jan., 1874) two successful cases in which he injected at intervals of seven or ten days half a drachm of Dr. Morton's solution, made by dissolving ten grains of iodine and thirty grains of iodide of potassium in an ounce of glycerine. The injection was thrown into the sac after the withdrawal of the spinal fluid. Dr. Morton had had some good results by the same treatment.

With respect to the *excision* of the tumor, a successful case has been recorded in the 'Path. Soc. Trans.,' vol. xiv, in which Dr. Wilson, of Clay Cross, removed the tumor five days after the closure of its neck by means of a clamp; and, when excision is entertained, this plan is probably the soundest. It should, however, only be thought of when the neck of the tumor is narrow, and there is no paralysis of the lower limbs or incontinence of feces or urine. In all broad-based tumors associated with paralysis, operative measures are out of the question.

Exceptional cases are on record of recovery, after every form of practice, but, on the whole, the results of treatment are not very encouraging.

Sacral and Coccygeal Tumors.

Congenital tumors are by no means unfrequent in the neighborhood of the coccyx or sacrum. They are sometimes composed of cysts, occasionally of fat or fibre tissue, and also of fœtal remains. They are generally central. Many of these have, doubtless, been described as false spina bifida, and, in rare examples, there is reason to believe they are cured cases of spina bifida, the sac of the hernia having been occluded at its neck by the natural contraction of the surrounding parts. I have seen one such case in an adult where the tumor was successfully excised. Mr. Pollock has recorded in the eighth volume of the 'Path. Trans.' an example of a congenital fatty tumor which he successfully removed from the central lumbar region of a child æt. 7; and, Mr. Athol Johnson, in the same volume, a rare case of fatty tumor clearly developed in the spinal canal itself. I have had occasion to remove a large congenital sebaceous cyst placed between the anus and coccyx from a child æt. 10; and from another child, a tumor containing fœtal remains, situated between the sacrum and the bowel. I may further refer to a third interesting case of cystic tumor of the sacrum, possibly spina bifida, in which the cyst burst, and complete recovery followed. The following are the brief notes of the two latter cases.

Marie B—, æt. seven weeks, was brought to me in 1868 with a congenital tumor the ize of a large orange projecting from between the bowel and coccyx, and apparently assing up in front of the bone (Fig. 78). It had been growing rapidly since birth, and was pressing upon the bowel, though the child in all other respects was healthy. I excised he growth, and found that microscopically it was made up of fat, fibro-cellular tissue, mucous membrane, cartilage, and bone elements. Recovery ensued, and the child has kept well.

A male child, two days old, was brought to me on July 30, 1868, with a large cystic tumor covering in the lower half of the sacrum and occupying the perineum (Fig. 79). It was the size of a cocoanut, and transparent as a spina bifida, yet in all other respects the child was well formed. The next day it burst and many ounces of blood-stained fluid escaped. The sac collapsed, but no evil result followed this bursting of the cyst. I watched the child for many months, and, on November 30, 1871, the tumor had contracted up to an irregular indurated mass of integument. The child was very healthy.

Fig. 78.

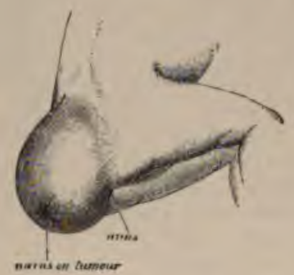
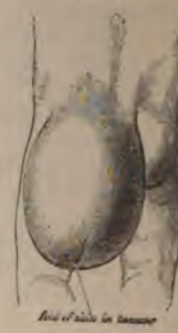


Fig. 79.



Congenital coccygeal tumors.

Treatment.—The only right treatment is the excision of the growth, which should be the general practice unless symptoms exist to contra-indicate any surgical interference, such as extensive or dangerous connections of the tumor. Care should always be taken to ascertain that no communication exists between the tumor and the spinal canal.

Hewett, 'Med. Gaz.,' vol. xxxiv.—*Behrend*, 'Journ. f. Kinderkrankheiten,' vol. xxxi.—*Nélaton*, 'Path. Chir.,' vol. ii.—*Holmes*, 'Surgical Treatment of Children's Diseases,' 1869.

INJURIES OF THE SPINE, CONCUSSION, &c.

The spine is a flexible tubular column composed of ring bones, alternating with a dense elastic intervertebral substance. These bones articulate by means of joints, and are bound together by strong yet elastic ligaments. From the upper orifice of the tube the spinal cord with its membrane is suspended in a chamber filled with cerebro-spinal fluid, and surrounded by large venous plexuses. The cord and its membranes are held in position by the nerve-trunks that pass with the processes of dura mater that accompany them outwards between the bones.

A local injury to the spine, such as a forcible bend forwards, may sprain or lacerate the ligaments that hold the bones in position. A still more forcible bend may crush the bodies of the vertebræ that form the anterior portion of each ring. If the force be still continued upon the broken bones, displacement may take place, when the delicate cord itself will either be slightly pinched between the displaced bones and contused, or completely crushed or divided. In the cervical and lumbar regions, the bones may be dislocated, the amount of injury to the cord depending entirely upon the amount of displacement that has taken place. When such displacement is very slight, the cord may be uninjured. Sprains of the back may also, at a later period, be followed by disease both of the joints and bones of the spine.

A diffused injury to the spine, such as that caused by a fall from a height upon the back, or by a heavy falling body, or a severe shaking as from a railway accident, may produce some fracture or dislocation of the bones of the spine, but it must to a certainty cause a severe shaking or concussion of the spinal cord itself, as manifested by a more or less complete suspension of all the functions of the cord, either for a short period or for life. This concussion of the spine may be accompanied by hemorrhage into or upon the cord, giving rise to compression, or may be followed by acute or chronic intra-spinal inflammation, terminating in paralysis and death.

In *both local and diffused injuries of the spine the gravity of the case depends chiefly upon the amount of injury the cord has sustained;* a severe local injury to the osseous part of the spine can be completely repaired without danger to life, whilst any injury to the cord and its membranes is fraught with danger, either directly by suddenly arresting the functions of the parts to which the injured nerves are distributed, or, indirectly by setting up chronic inflammatory changes in the cord.

When the functions of the cord have been directly suspended by any local or diffused injury to the spine, the patient is said to have suffered from *concussion of the spine.* Should the symptoms be complete and persistent, there is good reason to believe that the cord has been crushed by same displacement of a fractured or dislocated bone. Should some interval of time have taken place between the receipt of the accident and the paralysis, there is a fair suspicion that the paralysis is the result of some hemorrhage into or around the cord. Should the paralytic symptoms have followed the accident after a few days, and be attended with constitutional disturbance or spasm of the muscles of the limbs, the cause of the paralysis was probably some inflammation of the cord and its membranes; and, should the paralysis have been of a slow and progressive nature, the probabilities are that it is the consequence of some chronic softening of the cord; because all these different results have followed local and diffused injuries to the spine, moreover it is the knowledge that they may take place which renders any spinal injury a matter of importance, both as regards the immediate effects of the injury and its secondary consequences.

In rare instances, symptoms similar to tetanus follow spinal injury. I have seen such in two cases. One was that of a man, æt. 35, who fell from a height on his head, bending the neck forward. He was paralyzed for a few hours from the neck downwards, and, on the appearance of reaction, had marked tetanic symptoms with the contracted brow and risus sardonicus. Spasms could be excited on the slightest touch being applied to his neck. In twelve hours, however, all these symptoms disappeared, and recovery ensued.

In the second case, a man received a crush in his loins, between two carts. Lock-jaw followed, with general spasms of all the muscles of the body. In five hours the spasms subsided, but they were followed for five days by hyperæsthesia of the integument, and, on the sixth day, by weakness of one leg. In a month he was convalescent.

In former chapters it was shown that the functions of the brain may for a time be interfered with or suspended by a simple shake or concussion of its substance; that a severe concussion may give rise to contusion of the brain, either at the seat of injury or on the opposite side by contre-coup; that extravasation of blood either upon the surface of the brain or within its structure may follow such an injury; that fractures of the skull are of importance in proportion to the severity of the intra-cranial complications; and that intracephalic inflammation is too frequently the result of any head injury. In injuries to the spinal column and its contents similar results have to be recorded. A *simple concussion* of the spine may produce a partial or complete suspension of the functions of the cord; yet by rest and quiet these symptoms may disappear, and a perfect recovery follow. A *more severe concussion* may give rise to some injury of the nervous structure; to some extravasation of blood upon or into the cord itself. Such a complication will necessarily be associated with more marked symptoms, more complete and persistent paralysis and anæsthesia of that portion of the body supplied with nerves from the injured centre; the completeness and persistency of the paralysis and anæsthesia depending upon the severity of the mischief, and on the seat of injury. When the paralysis is severe but *incomplete*, there will be retention of urine, this symptom arising from the loss of voluntary power over the muscles that regulate micturition. But, when the paralysis and anæsthesia are *complete*, there will be absolute paralysis of the bladder and all its muscles, with incontinence of urine. This incontinence, however, must not be confused with the dribbling of an over-distended viscus from retention, such as occasionally occurs in the less severe cases.

When the injury is in the cervical region, one or both arms may be more or less paralyzed; when in the lower dorsal, one or both legs; but, as a rule, the paralysis is symmetrical and the symptoms depend on the nerves that are involved. The loss of sensation is also generally complete. In one case, however, there may be paralysis of one limb and loss of sensation of the other; in a second, exalted sensibility with paralysis. In one, the power of motion may be regained, while that of sensation remains lost, and in another the reverse; indeed, on these points there is every possible variety, the seat of injury clearly determining the nature of the paralysis.

Brown-Séquard's observations and experiments on the decussation of the motor and sensory fibres of the cord, have done much towards the elucidation of these points, and it may now with some confidence be asserted, that when one antero-lateral column of the cord is divided or irreparably injured, there must be motor paralysis of the same side of the body below the seat of injury, and loss of sensation upon the opposite side of the body

—the motor paralysis being due to the destruction of the white substance, and the loss of sensation to that of the gray.

When any portion of the white substance is left intact, some motion will remain, and, when any part of the gray is uninjured, some sensation. Complete division of the cord is necessarily followed by complete paralysis and loss of sensation in the parts below, although by what is called reflex action, the muscles of the parts may be made to contract on the application of any stimulant, such as tickling, to the sensory nerves.

Pain in the course of a sensory nerve, or in an extremity, is to be taken as representing the irritation of the cord or nerve at its central origin, and, in cases of fracture, as the spot where the bone has been broken. Symmetrical pains mean central mischief, unilateral pains local.

A severe blow upon the upper cervical region may produce according to Erichsen instantaneous death from concussion. When the *vagus* nerve is affected, a sense of suffocation, with irregular action of the heart, or constant vomiting, may be produced. When the *spinal accessory* is injured, spasms of the trapezius or sterno-mastoid muscles occur; and irritation of the *phrenic nerve* causes hiccup, as well as the sensation of an iron band-like constriction round the body. When the injury is in the lumbar region the paralysis is always partial, as the cord terminates at the second lumbar vertebra.

The *temperature* of the paralyzed limb is always lower than the rest of the body, even when to the patient it may feel hot or burning.

The *prognosis* in any case of concussion of the spine depends entirely upon the changes that are produced in the cord by the injury; and these are fairly to be measured by the severity of the symptoms and their *persistency*. This latter guide is very reliable, the persistency of symptoms being generally indicative of organic change. Again, when organic change has taken place there is the greater probability of some secondary inflammatory action in the injured part, and on this the prospects of the case hinge; for in injuries to the spinal cord or membranes, as in injuries to the brain, this intra-cephalic or intra-spinal inflammation is the cause of danger or of death in every case that survives the immediate effects of the accident, while it leaves, even when life is spared, more or less complete paralysis of the parts below the seat of injury.

INTRA-SPINAL INFLAMMATION.—SPINAL PARALYSIS AFTER CONCUSSION.—RAILWAY CONCUSSION.

INTRA-SPINAL INFLAMMATION.—"Every injury of the spine should be considered as deserving of minute attention. Inflammation of the cord and its membranes may supervene upon very slight injuries of the spine; it may advance in a very insidious manner, even after injuries that were of so slight a kind that they attracted at the time little or no attention."

Thus wrote Abercrombie in 1829, and his observations are as true now as they were then. Upon such views, the whole treatment of injuries to the spine, simple or severe, ought always to be based.

The preventive treatment of spinal as of head injuries means the adoption of such measures as experience has proved are most valuable in warding off the accession of intra-spinal and intra-cephalic inflammation, and thus preventing paralysis. The simplest shock or concussion of the spinal cord; the slightest blow upon the spine or sprain of its ligaments; any bruising of the former or laceration of the latter; and *à fortiori*, any severer lesion, is apt to be followed by an acute or chronic intra-spinal inflammation, and, by changes in the structure of the cord that may give rise to a paralysis, partial or complete. The surgeon has, moreover, no guide by which to measure the danger or calculate the probabilities of the occurrence of this secondary inflammation, since it may follow a slight accident, and fail to follow a severe one. In a general way, the prospects of its appearance and its danger depend much upon the gravity of the injury.

When the cord has been much contused or crushed by a fractured or dislocated vertebra, the paralysis that necessarily follows such a lesion is not likely to be aggravated by any secondary inflammatory changes in the injured cord, although the termination of the case may be hastened by these changes. Under such circumstances, the complication is not of such a nature as to add to the surgeon's anxiety. In less severe examples of injury, however, in which the primary symptoms do not indicate any organic lesion beyond that which manifests its presence by some temporary suspension of the functions of the cord, it becomes a matter of primary importance to recognize the very earliest indication of inflammatory action, in order that it may be arrested; for, as it has been shown, that the chief aim in the treatment of all these injuries is, to prevent the occurrence of inflammation, so the second is, to try and arrest its progress as soon as it has appeared. When it has become thoroughly established, neither medical nor surgical art has much power in checking its progress or in correcting its effects; as the delicate structure of the spinal cord appears to be incapable of undergoing material repair when softened by disease or crushed by accident. The cord structure when once destroyed is replaced by means of a fibrous substance. Paralysis or loss of function, under these circumstances, is permanent. In any case, therefore, of spinal injury, when the symptoms are persistent or tend to become worse; when after their partial or complete disappearance for three or four or more days they recur or appear in some altered form; when local pain is increased, and movement of the back is more difficult or distressing; when pain follows the course of the nerve trunks that emanate from the injured spinal centre, and muscular spasm or paralysis is present; and, moreover, when constitutional disturbance or general febrility is present; when any or all of these symptoms, few or many, are found to follow a spinal injury after the first effects of the accident have passed away, the diagnosis of secondary inflammation of the cord may fairly be made. and action taken upon it.

In general concussions of the spine, more particularly from railway accidents, when, owing to some general shaking of the body, the spinal cerebral, sympathetic, and circulatory systems are all more or less involved, there is an undoubted disposition for a chronic inflammatory change of a most insidious and creeping kind to supervene.

It is now well known that the primary spinal symptoms are often so mixed up with the general as that they are really masked; and, beyond a general but temporary loss of power and consciousness, there is often nothing special by which spinal mischief is manifested. On recovering from the shock of the accident and the mental disturbance, the sufferer often feels no definite injury, no local symptoms; nor is it till after some time has elapsed—the duration of which is also uncertain—that any special symptoms make their appearance.

Even then they are, as were their antecedents, vague and indefinite. It will probably be found that the patient has never been himself since the accident; he has been unable to work mentally or physically with the same force or energy that he did previously; is irritable in his manner, and perhaps feeble in his powers. Sleeplessness too has been more complete or common than it was before, and headache with general malaise, now often exists.

Some slight unsteadiness of gait is often the first observed symptom, a feeling of heaviness in the limbs, some abnormal sensation, such as that of pins or needles, numbness along the course of a nerve, cramps, perhaps retention of urine; or some evidence, in fact, of want of control or power over the muscular apparatus, and more marked generally in the lower extremities than in the upper. The centres of sensation may, at the same time, show indications of disturbance, either by a state of lessened sensibility, or perhaps by a hyperæsthetic condition. From symptoms such as these the attention of the surgeon is probably arrested. On testing the muscular apparatus thoroughly, it will probably be found, that the patient will be unable to stand steadily on one leg, or, what is a better test, if he place his heels together, he will totter on making the attempt to raise his body on his toes. When asked to stoop to pick up anything from the ground, he will probably bend his knees rather than his back; and walk with a rigid spine. On giving him a small object, such as a pin, he will take it clumsily and with tremor; will fumble at most things with his hands, and stumble at anything that is in his way.

On examining the spine some tenderness may be manifested on firm pressure, but probably only in certain places. Percussion on the bones is hardly a fair test; when employed, it should be indirect, through the fingers. Pressure applied to the spine causes at times severe pain, as does any movement; it is the latter condition which induces the rigidity of the spine in walking, before alluded to.

The brain and organs of special sense may likewise be affected, either by over or under sensibility. *Vision* may be imperfect either in one or both eyes; *hearing* may be oversensitive or defective; *taste* and *touch* may be perverted or lost; and *smell* at times destroyed or morbid. In fact, the whole nervous system, cerebral and spinal, may be disturbed, and its functions more or less damaged.

The course which such cases run is very uncertain, and the prognosis is, therefore, difficult. When the motor power has been lost from spinal mischief, the best test is galvanism. A healthy muscle supplied from a healthy nerve centre will always contract on the application of the galvanic current. When the nerve centre is so diseased as to cause paralysis, the galvanic current produces no movement—no contraction. This test is beyond the patient's control, and cannot be resisted; it is consequently valuable.

In interpreting these symptoms, more particularly in a railway case, or in any where the question of damages is involved, it is most important for the surgeon to separate the symptoms of which the patient complains—the *subjective*, from those he can himself perceive—the *objective*. Let him doubt and cross-examine in every way upon each of the former to test their accuracy. He may rely, however, upon the latter, and any positive opinion ought to be based upon these alone. There always hangs a suspicion over the former, because self-interest points to making the worst of them.

All the symptoms, taken as a whole, undoubtedly indicate a chronic or subacute inflammatory change of nerve-tissue, an inflammation of the membranes or of the cord. When they appear as a consequence of a general concussion of the spine, the cord is probably the seat of mischief, its delicate structure being more liable to injury than the tougher membranes, and, consequently, to secondary changes. When they follow some local injury, such as a twist, blow, or forcible bending of the back with laceration of ligaments, the disease in the cord probably is secondary to disease in the membranes, the inflammation of the latter being due to the extension of inflammatory action from the injured part inwards. "Inflammation of the membranes of the cord, as of the brain, is a disease not idiopathic, but proceeding from some cause without." (Wilks.) But, wherever this commences, it is progressive, and, in the end, involves all the tissues in its destructive changes.

The pathological changes themselves are tolerably definite. In the cord they put on the appearance of red softening in recent disease, and of white in chronic. The parts are soft and pulpy, the microscope showing them to contain granule-corpuscles and elements of the inflammatory process. The white matter of the cord will appear at times sound, while the gray substance is soft. The disease may be local or more general. In concussion, the latter is the more common condition. When it is in the cervical region, death is rapid, when in the lower dorsal, life may be prolonged for some time. This fact is well illustrated in fracture and dislocation of the spine.

TREATMENT.—In all cases of concussion of the spine, simple or severe, *absolute rest* in the horizontal posture is most essential, and, in mild cases, this is probably the only treatment called for; the symptoms, by the observance of this rule, gradually disappear, and the health is restored. The prone position in more severe cases is generally to be preferred to the supine, but the best guide in this matter is the ease which the patient experiences. The surgeon, however, must enforce quiet for many days after the disappearance of all symptoms, even in the mildest cases, on account of the primary danger of intra-spinal inflammation; and the period of rest to be enforced must be in proportion to the severity of the symptoms. In cases of railway concussion, this practice is of primary importance, and I am disposed to attribute the frequent occurrence of obscure railway spinal cases to the non-observance of this rule. It is true that in the majority of cases there are no definite indications of spinal concussion after the accident, though the nature of the accident itself is a sufficient guide to the case. A general shaking of the body means a general concussion of the spine with every other part, and the nerve centres by reason of their structure are most liable to injury. It would be well, therefore, to keep all patients who have been the subjects of such injuries quiet and in repose for several weeks after the accident. By doing this, much mischief would often be avoided.

After concussion, when severe local pain is experienced, relief is often given by the application of a dry cupping glass on either side of the painful part, and the operation may be repeated. In exceptional cases the local extraction of blood may be found of benefit. The ice-bag is a powerful remedy for good when there is much effusion of blood or pain in the part, and when the symptoms of reaction are too marked.

The diet should be nutritious, but unstimulating, and nothing likely to keep up or cause mental or physical excitement allowed. When recovery of power in the limbs is slow, and no symptoms of secondary inflammation of the cord exist, convalescence is promoted by the application of electricity in one or other of its forms to the enfeebled muscles.

When symptoms of intra-spinal inflammation have appeared, some advocate moxas or setons in addition to the above treatment; and of the two the moxa is, perhaps, preferable. Mercury in one of its forms appears to be a valuable remedy, and the perchloride is, perhaps, the best preparation, given in doses of 1-16th of a grain two or three times a day, combined with bark, quinine, or some other vegetable bitter according to the wants of the patient. When mercury is inapplicable, the iodide of potassium should be substituted. Sedatives should be allowed to procure sleep, and the hydrate of chloral seems to be the best, in twenty or thirty grain doses, at bedtime. Should pain be constant, fifteen grains of the same drug may be given twice a day, a double dose being allowed at night. The extract of belladonna, in one-third of a grain or half-grain doses, is likewise a valuable sedative. Strychnine is a dangerous drug in spinal disease, at least in progressive spinal disease. It is a distinct stimulant to the spinal centres, and is, consequently, most injurious as long as any progressive inflammatory action exists. When only the effects of the disease remain and inflammation has ceased to manifest its presence, strychnine may be given. Should general feebleness exist, iron may be given with it; and I know of no nervine tonic so beneficial as the combination of the tincture of the perchloride of iron in doses of fifteen minims, with five minims of the tincture of nux vomica or one or two grains of quinine. Cod-liver oil is a valuable adjunct to all treatment in this as in many other cases.

Great care should be observed throughout the treatment of these affections to prevent the occurrence of bedsores. They form very rapidly when spinal paralysis is present. I have seen several instances in which all the soft parts over the bones sloughed, and the spinal canal was opened; while in others the sacral bone may partially exfoliate. The back should be kept very clean and dry, and occasionally sponged with spirit lotion. It should also be protected further by leather strapping, felt plaster, and by cushions of air or water.

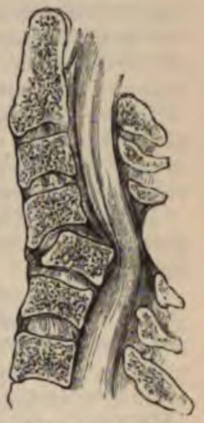
When retention of urine complicates the case, the utmost caution is required in passing the catheter. An elastic instrument should be preferred and of a large size, the French vulcanite catheter being the best. The catheter should be kept scrupulously clean.

FRACTURES AND DISLOCATIONS OF THE SPINE—WOUNDS AND SPRAINS.

In a practical point of view, it is expedient to consider fractures and dislocations of the spine together. They are not, however, invariably combined, for although in four-fifths of the injuries to the spinal column involving the bones some fracture is present, in the remaining one-fifth simple dislocation exists. The majority of these cases of pure dislocation occurs in the cervical region; in the dorsal, such an accident is almost impossible, while in the lumbar it is very rare. The difference in the anatomical arrangement of these divisions of the column affords an explanation of these facts. To the practical surgeon these points are, however, of small importance; that which concerns him the most in any injury to the spine has reference to the cord—how much injury has it sustained? Is it reparable or not?

When complete paralysis follows the injury there is little doubt that the cord has been injured. It may be that it has been more or less completely crushed by displaced bone, or even divided. In less severe injuries, less severe symptoms show themselves. Injuries to the cervical region are of greater danger than those of the dorsal, and these again are of more importance than those of the lumbar. The nearer the injury is to the respiratory centre, the greater the danger. Any crushing of the cord above the third cervical vertebra, is, as a rule, followed by instant death; this point being above the origin of the chief respiratory nerve, the phrenic. In cases of injury to the cervical vertebra giving rise to any symptoms of paralysis, death generally takes place within three days, and commonly within two. Thus, out of 36 fatal cases extracted for me by Mr. Rendle from the Guy's Records, 25 died in less than seventy-two hours, and 20 in less than forty-eight; 8 only survived the former period, and in those there were no symptoms of paralysis as an immediate result of the accident. Eleven of the 36 were cases of pure dislocation, 25 were examples of fracture and dislocation combined, and all were below the third cervical vertebra. In every case, also, of dislocation, the upper vertebra was thrown forward upon the lower, as seen in Fig. 80. Where spinal symptoms resulted the cord was more or less pressed upon, in some instances crushed, and in others bruised.

FIG. 80.



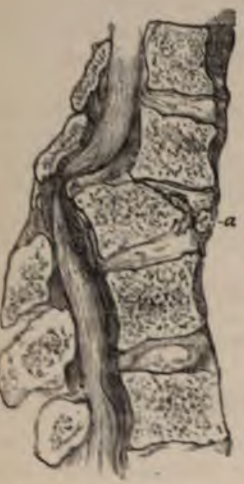
Dislocation of the spine. Guy's Hosp. Mus. No. 1033.

Fractures of the dorsal and lumbar vertebræ associated with displacement, and giving rise to paralysis below the seat of injury, are less speedily fatal than those of the cervical region.

Fracture of the spine may, however, take place and not be associated with any paralysis. The spinous processes of any of the vertebræ may be fractured, and no spinal symptoms follow. This accident is generally the result of a direct blow. When I was a dresser I saw a case of fracture of the spinous processes of three cervical vertebræ associated with a temporary paralysis, and in this instance complete recovery ensued; I have since treated successfully a case of fracture and displacement of the spinous process of the fourth cervical vertebra without paralysis.

In other cases, fracture of the spine may take place and not be detected until after death. Examples of this are not uncommon. In such, the cord is not involved nor any of the nerve trunks. The following case illustrates these points. In 1857, a woman, in an attack of mania, was admitted into Guy's under the care of Mr. Cock, for some contusion of the back caused by a fall out of a window. Beyond the contusion, no injury could be made out. There was no paralysis, but, on the contrary, violent muscular movement, the patient being maniacal. On one occasion she got out of bed and struggled to open a window to throw herself out. She lived sixteen days, and during the last week of life rested quietly in bed, with her eyes closed. She would only at times rouse herself and speak. After death, atrophy of the brain was found, with general fatty degeneration of the viscera. The last dorsal and three upper lumbar vertebræ were fractured through their bodies, but not displaced; one or two spinous processes were also fractured. The spinal marrow was uninjured. The fact of there being no displacement of the broken bones, and no injury to the cord, prevented a correct diagnosis being made.

FIG. 81.



Fracture of spine. Guy's Hosp. Mus., No. 1035^{28}.

I have seen also a case of fracture of the spinous processes of the last dorsal and the first lumbar vertebræ with lateral displacement, the injury having been treated for some months previously as a simple contusion of the back. In this case no paralysis existed or other spinal symptoms.

Fractures and dislocations of the spine are generally the result of *indirect forces*, such as severe falls. A forcible bending forward of the cervical spine may cause dislocation of the cervical vertebræ, and a similar accident to the dorsal spine may cause fracture. In these cases, too, there is always some laceration of the ligaments and crushing of the anterior edges of the bodies of the vertebræ. (*Vide* Fig. 81.) A forcible bending backward of the spine may produce a like result, the laminæ of the dorsal or lumbar vertebræ, under these circumstances, being much broken. Direct violence to the spine in the cervical region may cause dislocation; and in the lower vertebræ it generally causes fracture of the spinous processes or laminæ. Mr. Holmes has recorded in the 'Path. Soc. Trans.,' vol. x, an interesting case of displacement of the last dorsal from the first lumbar vertebra, associated with some slight fracture of the processes, the result of a direct blow.

Fracture of the sternum is not uncommonly associated with injuries to the spine from the forcible bending forward of the head. It was found in four out of fifty-six fatal cases that occurred at Guy's.

Of these fifty-six fatal cases of fracture and dislocation of the spine, thirty-six were of the cervical region, eleven being examples of pure dislocation, eighteen of the dorsal, and two of the lumbar; injuries of the cervical being apparently twice as frequent as those of the dorsal region; the greater mobility of the cervical vertebræ and the obliquely horizontal aspect of their articular processes favoring dislocation.

In the thirty-six cervical, the injury was below the third vertebra in all but three examples. In one of these, it involved the second, third, and fourth vertebræ; in another, the arch of the atlas and spinous processes of the second and third vertebræ; and, in the third case, the bodies and arches of the third, fourth, and fifth vertebræ.

In the eighteen dorsal, seven were in the upper and eleven in the lower half, the lower part of the cervical and of the dorsal regions being clearly more liable to injury than the upper.

When the cord was sufficiently injured in the cases of injury to the cervical region to give rise to paralysis, death generally took place within three days, and, in the majority of instances within two.

When it occurred as a result of injury to the dorsal region, suppuration of the kidneys, cystitis, or bedsores were the most common causes of death.

Of the eleven cases of pure dislocation of the cervical vertebræ, four were between the fourth and fifth; two between the fifth and sixth; three between the sixth and seventh; and two between the seventh cervical and the first dorsal. In none of these was there the smallest trace of fracture. In six, the displacement was so great as to crush the cord. In five, there was no displacement and no marked paralysis as a direct result of the injury, although secondary paralysis appeared subsequently, from stretching or other injury to the cord.

In injuries to the cervical region, pure dislocation occurs in thirty per cent of the cases.

Cases of sudden death after a fall from a height upon the vertex are, doubtless, often due to a fracture or dislocation of the cervical spine. It may be a fracture of the processus dentatus of the axis; a laceration of the transverse ligament binding it in position; or a fracture of the atlas allowing the head to slip forward. Dislocation of the occipital bone from the atlas has been described; it is, however, very rare.

When fracture of the odontoid process takes place, as it may from external violence, or during the progress of some disease in the vertebræ, death, as a rule, occurs suddenly; the victim being literally pithed. In other cases, and these generally of disease, the displacement may be gradual; death being then often preceded by paralysis of an arm or leg, or both, with difficulty in swallowing, pain in the neck, and inability to raise the head into the erect position, or to rotate it.

Vide paper on fractures of the odontoid process, by Dr. Stephen Smith, of New York ('American Journal of Med. Sci.,' Oct. 1871).

Diagnosis.—When a palient has received a severe injury to the spinal column followed by complete paralysis, there can be little doubt that the cord has been injured, and that a fracture or dislocation with displacement of the vertebræ has taken place. When the paralysis is partial, it is probable that the cord has been only partially involved, being more or less bruised, or stretched, according to the nature of the accident, and the extent of the displacement of the injured bones. When no paralysis is present the diagnosis is difficult.

When any inequality or irregularity in the spinous processes is present; any pain in one spot aggravated by pressure; any crepitus on manipulation; any local effusion of blood about the spine; any inability to move the spine or support the body; when priapism appears early in the case; when one or more or all of these symptoms come on after such an accident as is liable to produce them, the diagnosis of a fracture or dislocation is tolerably clear.

When paralysis of an arm or leg follows a spinal injury, it is possible that the paralysis may be caused by some partial displacement of the injured bone, by pressure upon one or more of the nerves that pass outward from the spine, or, by laceration of a nerve trunk. When paralysis is incomplete, the motor power is generally more completely lost than that of sensation; indeed, it often happens that there is hyperæsthesia in that portion of the body contiguous to the paralyzed part, owing to the portion of cord above the injury being over-active or irritated by the sharp parts of the fractured bone. Intense pain in the line of junction of the paralyzed and non-paralyzed parts signifies fracture in Mr. Erichsen's opinion. In estimating the seat of injury from the position of the paralysis, it is right to remember that the nerves come off obliquely from the spinal cord and pass downwards, the cervical and dorsal nerve trunks leaving the spine one vertebra or two vertebræ lower than the spot whence they are given off; while the cord terminates at the second lumbar vertebra. Thus, when fracture takes place below the second lumbar vertebra, there may be no paralysis. The patient may be unable to stand or walk wholly or in part, but place him on his back and there will be free movement of his legs. In other cases, the nerve trunks around the cauda equina may be involved.

When a patient has received a severe spinal injury, there may or may not occur what is called "shock;" but when these symptoms have passed off and those of reaction appear, there will commonly in cervical injuries exist some throbbing of the arteries and increase of the temperature of the paralyzed parts. These conditions are due to paralysis of the arteries as a result of injury to their vaso-motor nerves. At a later period, however, this increase of temperature subsides, and a diminution can be detected. In exceptional cases the vaso-motor paralysis is associated with coldness of the parts, and it is probable, that when this coldness exists, it is due to great depression of the heart's action.

Prognosis.—The nearer the injury is to the respiratory centre the greater the danger to life. Thus, in injuries to the cervical spine above the origin of the phrenic nerve or third cervical vertebra causing paralysis, death may be instantaneous; when below this position, and the respiratory process is maintained only through the diaphragm, life is rarely prolonged beyond the third day, and, as a rule, not beyond the second. Mr. Hilton has, however, recorded in his lectures 'On Rest' a case in which a man lived for fourteen years completely paralyzed from the neck downwards, after a fracture of the cervical vertebræ. A gentleman, aged twenty-nine, whom I saw with Mr. Roberts, of Southgate, November 25th, 1870, with complete paralysis of the whole body below the fifth cervical vertebra, caused by a fall upon the neck, was still alive in 1877, breathing solely by the diaphragm.

When the cord has been injured in the lower dorsal or lumbar region, life may be prolonged for many months, the immediate cause of death being generally some renal or vesical mischief, some bedsore or other complication the direct result of loss of nerve power in the paralyzed parts. The longer these complications are delayed by careful nursing and attention, the longer can life be maintained.

In other cases, again, in which only partial or no paralysis at all is present as a direct consequence of the injury, inflammatory changes may ensue in the injured part, and, spreading upwards, cause death. The prognosis in such instances will be mainly determined by the seat of the injury, and the extent of the mischief in the cord.

The lower the seat of injury, the better the prospects of a cure; and the less the cord is involved in the mischief, the greater the chances of a recovery.

Thus fractures of the lumbar region are quite capable of a complete cure, and fractures of the lower dorsal vertebræ are not unfrequently recovered from. Injuries to the cervical part of the spine are generally fatal, within three days. Injuries to the dorsal, when not proving fatal within the third week, may be survived for months, and even years, the duration of life being greatly determined by the warding off of the secondary complications which so frequently arise.

TREATMENT.—The diagnosis of a fracture or dislocation of the spine having been made, the most essential point to attend to is, to keep the part absolutely unmoved. The patient should be examined with the greatest care, and moved with every possible precaution, as any motion will necessarily add to the injury the cord has sustained, and increase the danger to the patient. Any manipulation of the injured part, beyond the gentlest, is to be condemned as being likely to prove hurtful. Extension of the spine may be employed when much deformity exists, or, when severe pain arises from nerve pressure, but extreme caution is required in following this practice; it is not to be employed in every instance, but only when local symptoms seem to suggest the probabilities of a successful issue. I have seen several cases in which marked relief was afforded by this course, and the records of surgery contain many more. Practised with discretion, extension of the spine is doubtless a valuable means of treatment.

When the patient is placed on his back, the parts have a natural disposition to fall into place; this position, therefore, must be maintained. The bed should be firm, yet elastic; and a water bed is the best, when it can be obtained; otherwise, a spring mattress or one of horsehair should be employed. It should be well protected by water-proof cloth, &c., from all contact with urine or feces.

The condition of the bladder should be attended to from the very first. Retention is certain to be present for a time, and, over-distension is most injurious. The utmost care ought to be employed in drawing off the water. A moderate-sized elastic or the French vulcanite catheter should be used, and the operation repeated twice a day, night and morning. If the urine becomes offensive, the bladder must be washed out; but no syringe should be used. A stream of water ought to be allowed to run in and out of the bladder through an elastic tube attached to the irrigator and fitted to the top of the catheter, no force being applied. (*Vide* Fig. 321.) The application of leeches to the spine, or cupping, is seldom called for. The condition of the bowels must be attended to, and enemata are to be preferred rather than purgatives. The greatest care is needed to keep the patient clean, particularly when incontinence exists.

There are no special medicines applicable to these cases. The general health of the patient should be maintained by tonics and simple nutritious food; and sedatives should be given to procure rest and relieve pain.

The condition of the back must be daily watched to prevent bedsores. This is best secured by removing pressure as far as possible, or in relieving it be means of soft cushions and pads, the water cushion being the best, and also by keeping the parts dry. The application of a soft felt plaster over the sacrum and hips is sometimes beneficial, so also is the frequent application to the parts of some spirit lotion. Should it be necessary to turn the patient on one or other side, the attendants ought to be taught to rotate the hips and shoulders at the same time. By great care and attention, life may be prolonged, and even recovery may occur.

The subject of trephining the spine requires brief consideration. Cline was the first to put it into practice, and, on his great authority, the operation has been repeated, but with no success. The great argument, however, against the operation is derived from the fact, that in few post-mortem examinations has the condition of parts indicated that the slightest good could have been derived from its performance. The danger of a fractured or dislocated spine lies in the injury to the cord, the result of a stretching or crushing of its substance. When the cord is much injured by the accident, the mischief has been done, and no removal of the displaced bone can undo it or neutralize its evil. If the cord is uninjured no operation is called for.

One successful instance of trephining is recorded by Gordon, of Dublin, and, in rare and exceptional cases, it is possible the operation may be justifiable. To perform it because it may by chance do good is not advisable. The onus of proving that an operation is likely to be of use, always devolves upon the surgeon who performs it. There is, however, reason to believe, that a cord may at times be only squeezed or pressed upon by effused blood, and, under such circumstances, relief might be afforded by removing enough bone to take away the pressure, and thus give the cord a chance of recovering itself.

In the case of the young man referred to at p. 204, such a probability seemed reasonable, and three months after the accident I cut down upon the injured vertebra, and removed the spinous process and lamina of the fourth cervical, thereby exposing the cord. No harm followed the operation, although no immediate good was produced. The wound healed rapidly, and in the course of a few weeks, some slight power returned in the muscles of the shoulders, the patient being able to raise the arms from the bed. He, however, made no further progress; and yet I look upon the case as an encouraging one.

"The end proposed in an operation of this kind," says Le Gros Clark, "is to remove displaced bone which is supposed to press upon or irritate the cord; but it is most likely to prove abortive, from the inaccessibility of the displaced bone. If the cord have been crushed, and the operation have been consequently useless, probably life may thereby be only curtailed, but if the cord be not crushed, it appears to me that the best chance of the patient's recovery is thereby extinguished. Indeed, my conviction is that the operation has been advocated on the erroneous hypothesis that the spinal cord can be compressed without serious disintegration of its texture."

WOUNDS OF THE SPINAL CORD.

These are very rare in civil life. They may take place, however, as the result of a stab or gunshot wound. If the cord is injured, some symptoms of paralysis will appear, corresponding with the part that is involved; the extent of the paralysis and its seat fixing the position of the wound.

SPRAIN OF THE BACK.

The word "sprain" is very broad, and, when applied to the back is indeed vague. It may mean simply a stretching of the muscles or ligaments of the back, or a more complete laceration of the latter, and separation of the spinous processes of the vertebræ with exposure or injury of the cord. The number of articulations in the spine, numbering nearly eighty, renders such an accident as a sprain a common occurrence; any twist of the spine, or forcible flexion, may consequently injure some of these joints. Sprains may, moreover, be followed by acute or chronic joint disease of a serious and insidious nature. When the head is bent violently forward, the muscles and ligaments may be so torn as to give rise to effusion of blood, swelling, and severe local pain. When the body is flexed with violence not sufficient to give rise to fracture, there may be the same results, and so, also, when a man falls upon his buttocks. In each case there may be external evidence alone of injury, or, there may be evidence of some affection of the cord, such as is afforded by the presence of paralysis, proving that the cord has been stretched, if not permanently injured. If the symptoms rapidly or even gradually subside, no grave mischief probably may have taken place. When these are persistent or obstinate, a less favorable opinion should be formed. If the lumbar region is the part involved, it is not uncommon for hæmaturia to appear, and this may be slight and pass away, or be more persistent. It is not generally a very serious symptom, unless the kidney is ruptured; as a rule, it disappears gradually, and no evidence remains that organic renal disease is ever the consequence. "Of the many cases I have witnessed," says Le Gros Clark, "I have never had reason to suspect that nephritis or organic disease followed." ('Brit. Med. Journ.,' Oct. 3d, 1868.) Mr. Shaw, in 'Holmes's Surgery,' gives a case where the bleeding lasted for four days, ceased for two, and then reappeared in all its severity. After the lapse of two more days it again ceased for twenty-four hours, reappearing for a third time severely, then ceasing, and a good recovery followed. When the kidneys are diseased, and when calculi also exist in them, this symptom is more likely to appear after injury.

Hemorrhage may take place into the spinal canal as the result of a sprain, or, laceration of the ligaments, the blood probably flowing from a laceration of some of the large veins that surround the cord, or from a spinal artery. Mr. Hewett has related a case of sudden death from a fall on the head, recorded by Dr. Deville in 1843 ('Mém. de la Soc. de Chirurg. de Paris,' t. iii), in which no other injury was found to the nervous centres than hemorrhage into the canal in its whole length. Mr. Le Gros Clark has recorded a second, in which a man was struck violently on the back, though there were no immediate spinal symptoms. Paraplegia soon followed, however, which extended upwards destroying life by asphyxia, and, after death, the theca was found distended with fluid blood derived from a ruptured spinal artery. He gives also another case somewhat similar in symptoms, though not in result, where the patient recovered after two years.

TREATMENT.—In all these cases of sprain, slight or severe, rest is essential, the sufferer being allowed to assume the position in which the greatest ease can be obtained. The application of ice in a bag is also of great service where much swelling or pain exists. In other cases, a warm poppy fomentation gives relief, or a mixture of belladonna and opium rubbed down with glycerine and applied on lint. When spinal symptoms are present, the greatest caution is needed, and the case ought to be treated as one of concussion of the cord.

Preventive treatment is all important, to ward off secondary inflammatory changes both of the spine and cord.

Rest in the horizontal position for seven or eight weeks is essential in all severe cases, and, even in milder forms, exercise must be sanctioned with caution.

When hæmaturia occurs, it requires no special treatment unless severe. Gallic acid, in gr. v or gr. x doses two or three times a day, may then be given, but, as a rule, this is not necessary.

CURVATURE OF THE SPINE.

There are two forms of curvature of the spine, *lateral* and *angular*. The *lateral* is due to a relaxation of the ligaments and muscles of the spine, which, in a healthy subject maintain the bony column in its normal position. The *angular* is caused by organic disease of one or more of the bodies of the vertebræ, or of the intervertebral substances. It is generally known as "Pott's curvature."

LATERAL CURVATURE.

This is by far the more common of the two, and is generally found in girls between ten and twenty years of age; sometimes in young children, and is frequently, not always, associated with some want of power. It is more common in the middle and higher classes of society, where sedentary occupations and luxurious enervating habits too often exist, than in young women who make full use of all their muscles and lead an active life.

It is encouraged by any one-sided posture of the body, whether this be the result of some faulty habit, or of occupation; of over-use of one limb, or of any disease or deformity of a lower extremity which occasions shortening of the limb.

In its early stage it is seldom discovered, and attention is, as a rule, drawn to the disease by some "growing-out" of one shoulder, generally the right, some distortion of the chest, or some tilting upwards of a hip. These deformities are frequently first noticed by dancing or drill masters. When a curve has taken place in the upper dorsal region of the spine to the right side, a compensatory curve is certain to be found in the lumbar to the left. In investigating a case, it is important to bear this fact in mind, as the consecutive or compensatory curve, unless of long standing, will soon be remedied when the original one has been cured.

In some subjects there exists an exaggeration of the natural curves of the back. When it is in the upper dorsal region and backwards, it is called *cyphosis*, when in the lumbar and forward, *lordosis*. This latter curve is very frequently found as an accompaniment of hip disease, and in *rickets*. It is always present in congenital displacement backwards of the head of the femur.

Associated with the lateral curvatures there necessarily must be some rotation of the spine. The amount of this is very variable, and depends upon the extent of the curvature; it is, doubtless, due to the forcible bending of the bones downward with the ribs, these latter helping to rotate the vertebræ upon their axes. The bones may be so twisted that their transverse processes project backward, carrying the ribs with them, the anterior surfaces of the bodies of the vertebræ looking towards the convexity of the curve, and the spinous processes laterally towards the concavity. The thorax is thus much distorted, the side corresponding to the curve being expanded, and the opposite one greatly contracted. This is well seen in the annexed drawings, Fig. 83 taken from a living patient, and Fig. 82 from a preparation.

FIG. 82.

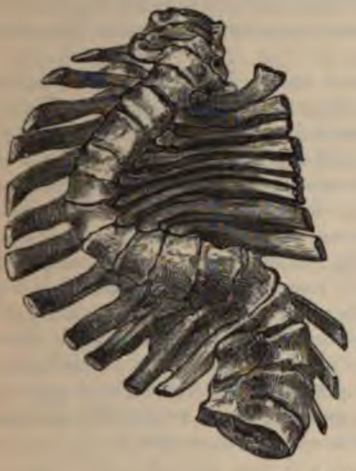
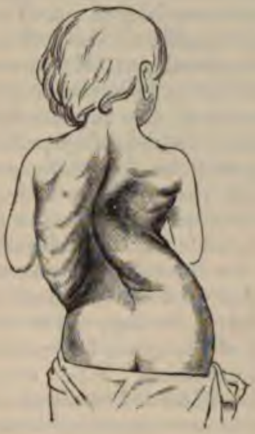


FIG. 83.



Lateral curvature of the spine.

Anterior view. Posterior view.

Guy's Hosp. Mus., No. 1006^{80}. Taken from Emma J——, æt. 14.

The diagnosis is not very difficult when the deformity is well developed, the double curve giving the spine a sigmoid form, which is typical. In less severe cases this curve can readily be removed by extension of the body, either by lifting the patient from the ground by a hand in each axilla, or by, what is better, the vertical suspension of the patient by his hands from a bar or a pulley. In the more severe forms, such as that shown in the above drawings, the deformity is permanent, the ribs are thrown out in an extreme degree, pushing the scapula outwards and upwards, and the lumbar curve is in the opposite direction to the dorsal. The whole thorax, abdomen, and pelvis are altered in shape and position by the deformity.

TREATMENT.—In treating these cases it is necessary in the first place to determine the cause of the deformity. Should there be any structural disease, such as a growth, or carious bone, these will require attention, and the alteration in the spine becomes thereby a secondary matter. But in the great majority of cases of lateral curvature, the spinal affection is the result of impaired health, and constitutional remedies are demanded. The treatment must be directed to an improvement of the general health, and tonics, such as iron, quinine, and cod-liver oil, should be administered. Good air and good food are essential, and in certain cases local treatment is of great value.

The feeble muscles and weakened ligaments should have rest, though they are to be kept in health by moderate exercise, they are never, however, to be fatigued. If fatigue be experienced from walking one hour, such exercise must be curtailed to a shorter period. If backache be produced by exertion, less must be taken. Exercise is to be allowed, but not to the extent of producing fatigue. Sitting and standing ought not to be sanctioned. The patient should recline at stated intervals in any position that gives the greatest ease. When the deformity is definite and the dorsal curve is to the right side, as is nearly always the case, the patient should rest upon that side with a pillow beneath the right arm; the weight of the body in that position acting as an extending force upon the curved spine, and thereby tending to reduce the curve. By resorting to this practice two or three times a day for a definite period, depending upon the nature and severity of the affection, much good may be obtained and very severe curvatures remedied. Cold sponge or shower baths, if they can be borne, are always beneficial, so also is a moderately firm bed, a spring mattress being better than a feather bed. Gentle calisthenic exercises are valuable adjuncts to treatment when practised with discretion, and particularly the voluntary vertical extension of the patient's body by manual suspension from a bar or pulley; yet, it should be remembered, that a weak spine is being dealt with, and anything like violence may be very detrimental.

Should the curvature have been encouraged by any faulty habit, such as standing on one leg, or in one position, or the use of one arm, it is almost needless to say that the habit should be discontinued.

The objects of treatment are, therefore—1. To improve the general condition of the body. 2. To give rest to the strained and weakened muscles and ligaments. 3. To strengthen the muscles that support the spine by exercise, which must be carefully regulated to prevent fatigue. 4. To restore the spine to its normal direction by posture, and by pressure applied in the horizontal position.

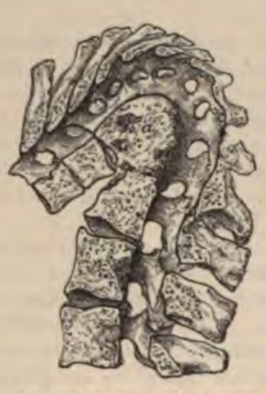
Mechanical contrivances have been much vaunted, and are often employed. I confess, however, to having little faith in their value as *curative agents.* They tend to cause atrophy of the muscles that support the back instead of strengthening them, and thus to make the deformity permanent. In bad and exceptional cases they may, however, be employed when the treatment sketched out cannot be borne or is inapplicable, and of all supports that of Sayre is the best. When the deformity is irremediable and support essential to allow the patient to move about, such an instrument is of great value.

It is probable that the deformity in its early stage chiefly arises from a compressed condition of the intervetebral substance, it being well known that this material is capable of being compressed one fourth of its thickness. Hence a person, by maintaining the erect posture during the day, will be an inch shorter at night than in the morning. Any lateral curvature of the spine, however produced, unless remedied, will increase and be complicated with rotation. When unequal vertical compression is therefore kept up, the deformity produced by it becomes permanent, and the growing bones necessarily assume shapes and positions corresponding to the deformity, and tending to increase it.

ANGULAR CURVATURE OF THE SPINE.

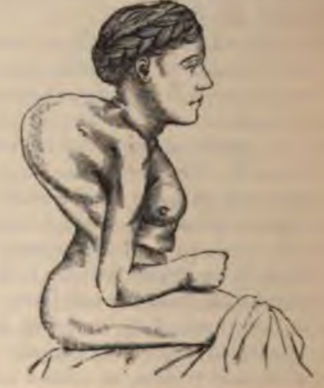
This, which is generally known as Pott's curvature, is due to a destructive inflammatory change of the bodies of the vertebræ and intervertebral substances. It begins usually in the latter structure, although the bone itself may be its primary seat, and is at times associated with tubercular deposit in the tissue, though there is no evidence to prove that it is always due to the presence of tubercle. The curvature is directly due to the destruction of the bodies of the vertebræ and the intervening intervetebral substance, the upper vertebra falling down towards the lower, and joining with it. When the bodies of many of the vertebræ are involved, the deformity will be severe; a preparation in Guy's Museum (1006^{50}, Fig. 84) shows the bodies of twelve vertebræ implicated, but a cure resulted. Paralysis may attend this affection, though it is rare to find the cord involved in the disease; the most destructive changes taking place in the bones; great deformity, even to an acute bending of the cord, may exist, without giving rise to nervous complica-

FIG. 84.



Angular curvature of the spine.

FIG. 85.



Angular curvature of the spine, the same as that illustrated in the former figure, taken from a patient æt. 35.

tion (Fig. 85). The paralysis too may be lasting, but more commonly is only temporary. Angular curvature may occur at any period of life, but is more liable to appear during the growth and development of the spine; and, consequently, is more frequently found in childhood. From a remarkable preparation in the Guy's Hosp. Mus. (1004^{92}) it would seem, that it may attack the fœtus in utero, the bodies of three or four of the dorsal vertebræ in this case being clearly fused together from disease, thus giving rise to angular curvature.

When a curve takes place, it is generally by anchylosis; occasionally, however, the parts are held together simply by fibrous tissue.

The disease more commonly attacks the lower dorsal region of the spine than any other, although the cervical and lumbar regions are not seldom implicated. In rare cases, it attacks two different regions of the spine. It may run through its whole course even to a cure, without giving rise to any external suppuration; more commonly, however, an abscess makes its appearance.

Spinal abscess.—Pus will sometimes find its way from the dorsal region beneath the fascia that covers in the psoas muscle under Poupart's ligament, and then appear as a swelling in the groin at its inner half (*psoas abscess*). The swelling may burrow downward, and involve the whole thigh in one large abscess. When the disease is in the lumbar region, pus may burrow between the dense layers of fascia that bind in the quadratus lumborum muscle, and appear in the front of the abdomen, above Poupart's ligament, or in the loin (*lumbar abscess*). In other cases, it will make its way under the fascia that covers in the iliacus muscle, and appear beneath Poupart's ligament, but at its outer half. In other instances, again, the matter will find a passage downwards into the pelvis, and either make its way through the sciatic notch into the gluteal region (*gluteal abscess*), or pass downwards behind the trochanter major to the thigh. In still rarer cases the pus appears by the side of the rectum.

When the cervical region is the seat of the disease suppuration may appear in the pharynx as a *pharyngeal abscess*, or externally in the neck behind the sterno-cleido-mastoid muscle. The following case is a good example of this:—

A boy, æt. 3, was brought to me at Guy's, in 1862, for some affection of his upper cervical vertebræ, consequent on a fall down stairs upon his head. An abscess formed two months after the accident behind the left sterno-cleido-mastoid muscle, from which a piece of the lamina of a vertebra escaped six months afterwards. He kept his bed for upwards of a year, when he got up with a stiff neck. He was unable to nod or rotate the head, clearly showing that the joints between the occipital bone and the first two vertebræ had been diseased and become anchylosed. In 1867 this boy again came under my notice. His head was quite fixed; the cervical vertebræ seemed shorter than usual, but no irregularity existed.

The annexed drawings (Figs. 86, 86A, 86B), taken from Ellen T—, æt. 14, a patient of Mr. Poland's, illustrate a severe case of cervical disease with lateral deformity. In this patient, a good result was obtained by means of the apparatus depicted in Fig. 86B, the cure resulting in anchylosis.

Fig. 86.

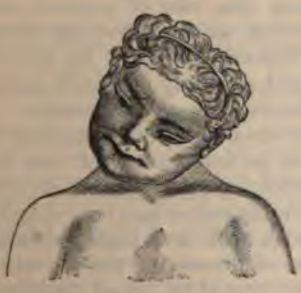


Fig. 86A.

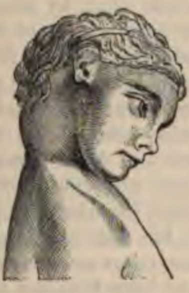
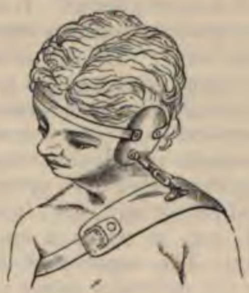


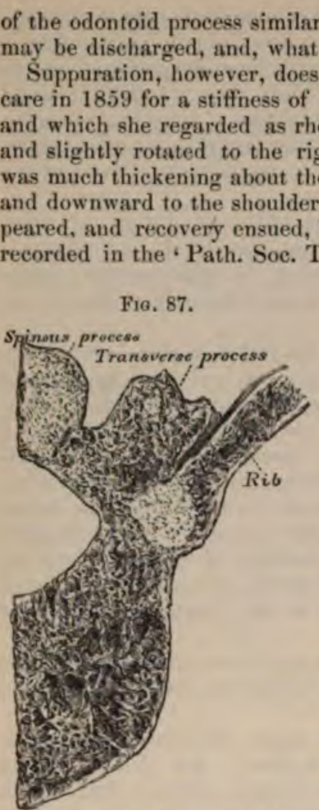
Fig. 86B.



From any of these abscesses bone may exfoliate, and it may be coughed up from the pharynx, or discharged through the neck. I have seen a mass of bone, the size of a nut, come away from a lumbar abscess, and a piece of bone, clearly spinal, discharged from an abscess of the thigh, opening above the knee-joint. In a case brought under my notice by a valued dresser, Mr. Burgess, the anterior half of the atlas, with its articular facets, was expectorated, recovery ensuing; and, in Guy's Hosp. Museum, there is a preparation of the odontoid process similarly got rid of. In fact, from all these *spinal abscesses*, bone may be discharged, and, what is more, recovery follow.

Suppuration, however, does not always take place. A woman, æt. 30, came under my care in 1859 for a stiffness of her head and neck, that had been increasing for two years, and which she regarded as rheumatic. When I saw her the head was immovably fixed and slightly rotated to the right side. Rotation and nodding were impossible. There was much thickening about the cervical vertebræ, with pains darting upward to the vertex and downward to the shoulder. By rest in bed, fomentations, and tonics, all these disappeared, and recovery ensued, but with a stiff neck. My colleague, Dr. Fagge, has also recorded in the 'Path. Soc. Trans.' for 1877 a remarkable case of synostosis of the arches of the vertebræ, of the ribs to the vertebræ, and hip-joint, in which a bending of the dorsal vertebræ forward with immobility were the only symptoms of spinal disease that existed (Fig. 87). It occurred in a man, æt. 34, who died with inflammation and dilatation of the bronchial tubes from asphyxia, his breathing having been entirely diaphragmatic from a want of movement in the costal joints.

Fig. 87.



Synostosis of ribs to vertebræ, &c.

Diagnosis.—When any acute angular curvature of the spine exists there can be no difficulty in recognizing the nature of the disease, or the process by which the curvature has been brought about. When a large abscess coexists with the deformity, there is good reason to suspect, that the one is the direct result of the other, more particularly when the suppuration can be traced up to the spinal deformity. The difficulty of diagnosis is felt in the early stage of the disease before any local change has taken place, and it is here that great care is needed, because if any decided good is to be gained by treatment, it is at this early period. What, then, are the indications which denote the presence of spinal disease? *Local and persistent pain* is probably the earliest, and when this is accompanied by *local tenderness* on firm pressure the surgeon's suspicions should be excited. When to these symptoms the patient exhibits a *rigidity of the spine* in walking or moving, when, on being told to pick up anything from the ground, *he bends his knees in preference to bending his back*, the diagnosis becomes more certain. When pain is detected in the course of any of the nerves coming from the seat of the affection; when the patient complains of any sudden jar of the back by a slip down stairs or by any jump; when any constitutional disturbance is present, such as a quick pulse, occasional febrility, and a furred tongue; when all these symptoms, or many in combination exist, during that period of life when bones are growing, and bone disease is apt to appear, the surgeon should always suspect disease of some portion of the spine, and, until he can satisfy himself that none such exists, it is a wise plan to treat the case as if it were present. It is true that, by adopting this rule of practice, he will be occasionally misled, and at times treat a case of hysteria as one of spinal disease; but then what harm? He will probably do good to the hysterical patient by the treatment he would adopt for the spinal complaint, while he would certainly do much harm to the latter, by neglecting such measures as are essential for its successful treatment.

TREATMENT.—It is an interesting clinical fact that the best cases of recovery from the worst examples of spinal curvature and disease are to be found amongst that miserable class of patients who have never had any chance of receiving proper treatment; who have never had rest or any care; in whom the disease has run its course unattended and uncared for, and, yet, in whom a cure has taken place with firm anchylosis, although with deformity. The majority of these cases are examples of disease of the dorsal vertebræ. How far this deformity might have been lessened or prevented by proper treatment, is an open question. Nevertheless it is beyond all doubt, that in the early stage of this disease, immobility of the spine, rigidly and persistently maintained, and the removal of downward pressure are absolutely essential points of practice to be observed. Not, however, rest upon the back, for in many instances this supine position tends rather to separate parts that ought to be kept in contact; but rest in any position, prone or supine, the patient feels to be most comfortable.

The general health of the patient must be maintained, as much as possible, by simple nutritious food, stimulants enough to assist digestion, and no more, with tonics, such as iron, quinine, and cod-liver oil.

When pain exists, local fomentations are often a comfort; occasionally too the application of a few leeches relieves. Small flying blisters placed alternately on either side of the painful spot are sometimes of use, and a plaster of belladonna or opium rubbed down with glycerine over the part, is a valuable adjunct. When severe nerve pain is present, the hypodermic injection of morphia may be used. Sedatives must be given to induce sleep when it cannot otherwise be obtained. Setons, moxas, and mercury are not to be recommended.

By the adoption of this line of treatment a cure may be obtained. It must, however, be followed out for months, and even years; the greatest care being taken that the patient is not released too soon, for a relapse is always a very serious affair.

Dr. Lewis A. Sayre's plaster-of-Paris jacket appears to me to be the best kind of apparatus, for it is simple, economical, easily applied, and efficient, securing absolute immobility of the spine, and at the same time giving comfort to the wearer. It can be readily applied by any medical practitioner with little expense, and does not debar the patient from the benefit of fresh air and change of scene.

Fig. 88A. Fig. 88.

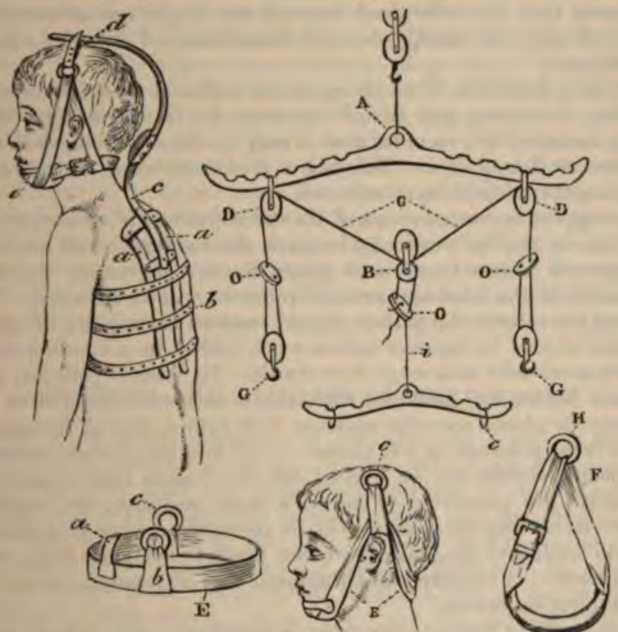


Fig. 88.—Description of Sayre's apparatus as improved by Golding Bird, by which the drag on the arms and head can be varied by altering the relative lengths of cords I and G. The smaller the angle at G the more the drag on the head, and *vice versa*.

A. Cross-bar suspended by running tackle to Sayre's tripod or to hook secured to cross beam of a folding door. B. Pulley, acting upon central bar, to the end of which are suspended the iron rings c, attached to head-piece, E. D. Pulleys connected with arm suspender, F, by hook G, and H, ring, worked by running cord 36 inches long, which can be lengthened at will and fastened by cleats, O. E. Head-piece made of 2-inch worsted webbing sewn into a circle 27½ inches for adult, 23 inches for children, with (*a*) chin-piece made of wash leather, and (*b*) two circular sliders of same web, 6 inches round, attached to iron rings, C. The sliders, by being slid forwards or backwards, can be made to pull more or less against the chin or occiput. F. Arm pieces made of 2-inch cotton web one yard round, capable of being shortened by buckle. They are softly padded with horse-hair in the middle, and covered with wash leather; each carries an iron ring, H. On first suspending a patient the running cord, G, should be at its shortest, the centre cord, *i*, at its longest.

Fig. 88A. Sayre's jury-mast apparatus.—*a*. Two pieces of malleable iron bent to fit the curve of the back. *b*. Three or more roughened strips of tin attached to iron, long enough to encircle the body. *c*. Central shaft carried in a curve over the top of the head and capable of being elongated at will, springing from cross pieces of *a*. *d*. Swivel cross-bar with hooks attached to end of *c*, from which straps depend to support head and chin collar, *e*. This apparatus is applied over the jacket with a plaster bandage.

The body of the patient to whom it is to be applied is first to be covered with a thick closely-woven merino shirt, which is to be fastened above over the shoulders, and below between the thighs; in a female over a handkerchief. A pad of sufficient size, which Sayre calls a dinner pad, is then to be introduced beneath this shirt over the region of the stomach, of sufficient size to supply, when it is removed, a space which will permit of distension of the abdominal parietes. The patient is then to be supported by straps carefully adjusted to the axillæ, symphysis mentis, and occiput (Fig. 88), attached to the extremities of a cross bar which may be suspended from a hook fastened to a beam or high door by a compound pully, the body being sufficiently suspended to allow of its weight serving as an extending force, but *always within the limit of pain.* The trunk is then to be carefully encased from below the crests of the ilia upwards to the axillæ by the rapid application of coarse muslin or crinoline bandages, 2½ inches wide, into which *dry freshly-ground* plaster-of-Paris has been rubbed, the bandages just before they are used being placed vertically in tepid water deep enough to cover them, and left a sufficient time to allow all bubbles to escape. The bandages should be well squeezed before they are rolled round the body, and in their application care should be taken to see that they are applied flat, without making any traction, and well smoothed down. It is well also during this process to wet the jacket with water, and rub in more plaster.

The patient should be laid down in the recumbent position upon a mattress before the plaster is quite set, the dinner pad removed, and the casing slightly flattened in front of the anterior superior spinous processes of the ilium, to guard against pressure. The merino jacket may then be unfastened beneath the thighs and above the shoulders, and turned at both ends over the casing, the ends being fastened down by a few extra turns of the plaster bandage.

In the course of a fortnight, if all things go on well and no evidence of undue pressure in any part exists, the casing may be split up along the front, its edges bound, eyelets introduced, and a lace inserted, in order that it may in times be removed for personal cleanliness and comfort, and reapplied. The jacket should be worn so long as it is easy, and when worn out another should be substituted.

Where extra support is needed strips of tin three quarters of an inch wide may be bound round the thorax, or applied vertically beneath the bandage; and when the cervical or upper dorsal region is diseased a vertical splint, Sayre's jury-mast apparatus (Fig. 88A), to take off pressure of the head and prevent rotation, will be required. When this splint is used for lateral curvatures the patient should suspend himself by his arms.

The dinner pad should be made of cotton wool, folded in a handkerchief so as to form a wedged-shaped mass with thin edge downwards. In female patients, a pad should be placed over each breast and removed with the dinner pad just before the plaster sets. Smaller pads may be placed over the anterior iliac spines, and all prominent spinous processes protected from pressure by felt plaster. "When the disease is situated in the dorsal region the jacket should not be opened, for the reason that if the respiratory movements of the chest are permitted to go on without restraint, the heads of the ribs will necessarily move freely and the disease will be increased rather than diminished. But if the ribs be held still, and the diaphragm thus made to act more fully, the breathing, instead of being thoracic, is rendered diaphragmatic and abdominal, and all the short, grunting, catching respiration ceases."

In *acute* or progressive disease suspension is dangerous, and vertical extension is to be applied with the greatest caution. Immobility of the spine is the essential object to secure.

Spinal abscesses should not be opened hastily, inasmuch as they may become absorbed and wither away. When steadily progressing, however, they must be dealt with, and the best method is without doubt to make a free opening under a piece of lint-saturated with oil carbolized or not. I have, however, in some cases, made a free opening into the abscess without any such precautions, and with an equally good result—making it so free that no pus could be retained, and, if air got in, it as freely got out again. Retained pus and air are sure to decompose, but if a free vent be made for both, harm rarely ensues. To allow abscesses to enlarge to any extent without interfering, is not good surgery, as the amount of constitutional disturbance that follows the opening of an abscess is closely proportioned to its size, and a large abscess cavity secretes more pus than a small one. It is true, that after the opening of a chronic abscess, a patient who may have been fairly well becomes feverish, and possibly exhausted by hectic; but it should be remembered, that by delay, the abscess will become larger, and the constitutional disturbance as a consequence more severe, when the opening has taken place.

Disease of the upper cervical vertebræ.—Disease of the upper two cervical vertebræ and of the occipital articulation is often found, and may be accounted for by the greater mobility of the joints, and consequent liability of the ligaments to sprain and laceration. Disease may be situated in the bones entering into the formation of the joints, or in the soft parts binding them together; and, with the disease, some displacement of one of the vertebræ is occasionally met with. When the disease is in the second vertebra, the odontoid process may separate and even exfoliate. Such a result took place in a case illustrated in Guy's Museum, prep. 1018^{15}, in which a woman who had had a stiff neck for months coughed up the necrosed odontoid process; recovery took place with a stiff neck, and four years subsequently, the woman was following the occupation of a barmaid.

When the transverse ligament is diseased, the odontoid process may become displaced and the cord injured (Guy's Museum, prep. 1289^{32}). When the displacement is great, sudden death may take place under these circumstances; and when partial, more or less paralysis may ensue, according to the amount of pressure the cord has sustained. Fixed pain about the cervical vertebræ with pain in the distribution of the occipital nerves and stiff neck, is always suspicious of cervical disease; and, when aggravated by rotation or downward pressure of the head, the case is serious. Under these circumstances, the aspect of the patient is very characteristic; the chin is tilted up, and all the muscles of the neck become rigid; the patient may even support the head with his hands.

TREATMENT must be conducted on recognized principles. The danger of sudden death by the displacement of the bones must be diminished by the application of a support to keep the head straight and prevent its falling forwards, and this may be accomplished by the application of a collar around the neck, passing under the chin with a support embracing the head, or by Sayre's jury-mast apparatus (Fig. 88A). Rest in the horizontal position is, however, of greater value, care being observed to keep a small firm pillow underneath the neck, to preserve the hollow, and in this way, as pointed out by Hilton in his classical word on rest, "to lift up the body of the second vertebra and remove the odontoid process from the lower part of the medulla oblongata, and thus prevent the fatal results of pressure upon it." At the same time the head should be kept at rest by means of sand-bags applied laterally. Remedies that have been mentioned in the treatment of angular curvature of the spine are here of use. In cases of severe spinal curvature, there is good reason to believe that the span of life is often shortened, on account of the interference with the respiratory and circulatory functions caused by the deformity. My colleague, Dr. Fagge, has written an interesting paper on this subject. ('Guy's Hosp. Rep.,' 1874.)

INJURIES AND DISEASES OF THE NERVES.

When a nerve is struck or contused, pain is produced, and it may be of a passing tingling character, or of a far more severe kind. Most people are rendered familiar with these facts, by an occasional blow upon the ulnar nerve, or what is called the "funny bone." When the blow has been severe, the pain may be lasting, and the functions of the nerve so disturbed or interfered with as to give rise to loss of power or sensation in the parts supplied by the injured nerve. A man, æt. 29, went to sleep with his elbow resting on a table, and when he awoke there was complete paralysis both of motion and sensation of the parts supplied by the ulnar nerve. When I saw him two days afterwards, these symptoms were very marked; there was also tenderness over the nerve behind the inner condyle; to which spot a blister was applied. In a fortnight returning sensation appeared, with some slight power of motion; and in five weeks he was well. This was clearly a case of paralysis of a nerve from contusion. A man, æt. 46, received a blow upon his ulnar nerve against a chair. No pain appeared at the time, but three hours later, pain and numbness showed themselves, and at this time some thickening over the spot could be made out. In the course of three weeks these symptoms disappeared and recovery was complete. In this case it would appear, as if some hemorrhage had taken place into the nerve sheath, giving rise to the paralysis, which disappeared as the blood was absorbed.

WOUNDS OF NERVES.

When a nerve is *wounded*, pain is produced, and this may be of a passing or more permanent character. In nervous, hysterical subjects the nerve pain is sometimes severe and persistent, and is then called neuralgia. It may be confined to a branch of the injured nerve, or it may involve the whole trunk.

When a nerve is *divided*, complete paralysis of the parts supplied by it follows. It may, however, reunite, and recovery may thus take place. Paget, in his 'Lectures on

Surgical Pathology,' third edition, has related a case of complete division of the median nerve, in which the trunk had nearly recovered its conducting power a month after the wound. I have seen a similar case in which recovery ensued in four months. The following is another example in point. A woman, æt. 30, came to me with an incised wound behind the inner condyle of the humerus. The ulnar nerve had been completely divided, and there was perfect paralysis of motion and sensation of the parts supplied by it. The edges of the wound were adjusted and the arm placed in a sling. A month later, she returned with a burning pain in the little finger, which was really cold, but red, swollen, shining, and blistered; and, when touched, some slight sensation was produced. Cotton wool and oiled lint were applied, and the arm was fixed upon a straight splint. The original wound had nearly healed. In two weeks the finger looked natural; sensation in it and all other parts supplied by the nerve had improved. In another month she returned with the old symptoms as bad as ever. They had reappeared upon the removal of the splint two weeks previously; but on its reapplication with the cotton wool, they again disappeared. The splint was then kept on for two months, when sensation became natural, complete repair having taken place in four months. When seen six months later, she was still well.

The red, swollen, shining, and blistered condition of a finger deprived of nerve force is characteristic, and is generally associated with the sensation of a burning pain and loss of temperature, amounting sometimes to a depression of 9° or 10° Fahr. These symptoms are clearly due to mal-nutrition. When the nerve repair does not take place, these symptoms are very apt to return from time to time, on any change of temperature or depression of the general power of the patient. When the ulnar nerve is completely paralyzed, in which case atrophy of the muscles supplied by it ensues, the aspect of the hand is very characteristic, the wasting of the interosseous muscles, with the abductor indicis (also an interosseous), and all those of the little fingers, giving rise to a peculiar hollowing of the parts between the metacarpal bones which is typical. Nerves, when divided, do not, however, always reunite. When a piece has been removed, either by accident or by design, as in the operation for tic douloureux, the restoration of function is very rare, though it may occur.

TREATMENT.—Bruised nerves are to be left alone, natural processes being, as a rule, amply sufficient to effect a cure. When recovery is slow and associated with pain in the injured part, the application of a small blister is beneficial. When a nerve is divided, it is well to put the divided ends as closely in contact as possible; to place the limb in such a position as will prevent any separation of the divided portion; to keep the paralyzed parts warm with cotton wool and of an equable temperature, and the whole limb at rest, until complete repair has taken place. The application of a suture to a divided nerve is a legitimate proceeding; though not, however, uniformly successful. Mr. Favell, of Sheffield, has recently published some evidence in favor of the practice ("Address on Surgery," 'British Medical Journal,' August 5th, 1876), and Dr. Weir Mitchell has shown that in 120 cases of nerve section, regeneration of nerve took place in most in about six months ('American Journal of Medical Science,' April, 1876). When much nerve pain exists belladonna or opium rubbed down with glycerine is a nice application, and the hypodermic injection of morphia is often of much value.

NEURALGIA, TIC DOULOUREUX.

The subject of neuralgia belongs more properly to the physician than to the surgeon, yet the latter is often called upon to consider cases of this nature. The first point to determine is whether the pain is due to any local cause, and, if so, to remove it. Thus, a decayed tooth too often is the cause of pain in the course of branches of the fifth nerve, although the tooth may have neither ached nor exhibited any external evidence of decay. The pressure of a small tumor on a nerve, some irregularity in the bone, or a cicatrix involving a nerve, are causes which sometimes require the surgeon's interference to effect a cure. The following example illustrates these remarks: A man, æt. 41, came under my care in 1866 for severe pain down the anterior and outer portion of his left leg and foot, with almost complete paralysis of the extensor muscles. The symptoms had been coming on gradually for years, and had followed a severe wound sustained twelve years previously, over the head of the fibula. There was a hard cicatrix over the head of the fibula, which clearly involved the external popliteal nerve. I made two deep vertical incisions on either side of the cicatrix, by this means taking tension off the nerve, and affording complete relief; six weeks later he was still well. Whenever neuralgic pain is associated with a cancerous tumor, or comes on after its removal, the surgeon should suspect the existence of some secondary cancerous deposit in the course of the sensory nerve.

The great majority of cases of neuralgia, however, have a constitutional origin, and their cause is to be found in some hereditary tendency, in depression, anxiety, or some obvious derangement of health, such as is expressed by the term anæmia. Many, too, have a malarious origin, and depend on climatic influences, such as residence in a damp or wet place. Cases of neuralgia are of frequent occurrence, and represent what would have been formerly ague, showing the influence of the miasmatic air. The disease known as "tic douloureux" is an affection of the fifth nerve and its branches, but any nerve in the body is liable to suffer. The pain is often very intense, and recurs in paroxysms at certain hours, or on exposure to draught or cold.

TREATMENT.—The treatment of these cases of neuralgia must be regulated entirely by their cause. When a local cause can be made out, its removal is the only remedy—for example, the removal of a tooth, of a tumor, or of a bulbous extremity of a nerve. When hysteria complicates the case, or any uterine disturbance, tonics are suggested, such as iron, zinc, or quinine, and of these full doses may be given. When malaria appears to be the cause, bark or quinine is invaluable. In local neuralgia, more particularly in *sciatica*, the hypodermic injection of morphia in one-third or half-grain doses often acts as a charm. The fluid should be injected in the course of the nerve, and all forms of neuralgia is of value. Chloroform, belladonna, and opium, locally applied, are also valuable. The general condition of the patient should always be attended to, and the treatment directed to its improvement. Good food, fresh air, and tonics, are always essentials. Purgatives are seldom necessary, and must be regulated so as not to depress. Stimulants, but not in excess, are of great use. In females, the condition of the uterine organs should always be carefully attended to.

In obstinate cases of neuralgia, the division of the nerve has been performed with occasional success. It is not, however, an operation in favor of which much can be said. When the cause of the neuralgia is peripheral, it may succeed for a time, but in these cases, spontaneous recovery is not unusual; and, when some central mischief is the source of the pain, the operation is not likely to be of service. Nevertheless, in desperate cases, the excision of a portion of the offending nerve is a justifiable operation; it has been of use, and may be so again. Sir J. Fayrer has related in the 'Medical Times' for 1868 a case of sciatica in a syphilitic man, æt. 30, in whom swelling was detected in the nerve sheath, and pain was at once relieved by puncturing the part with a knife.

NEUROMA.

Any tumor connected with a nerve is called a neuroma. These neuromata may be of a fibrous or of a fibro-cellular kind, and there is reason to believe that they have an inflammatory origin. They may be very small, or of large dimensions, and when large, they may contain cysts. Sometimes they are developed *within* the nerve sheath; at others they are situated *upon* it. In a third class the fibrillæ of the nerve trunk appear to be separated by the new tissue, or to become incorporated with the growth. They are at times single, but more frequently multiple; and occasionally involve nearly every cerebro-spinal nerve in the body. Wilks has recorded such a case in the 'Path. Soc. Trans.,' vol. x, in which, after death, neuromata were found all over the body, appearing as nodules on some nerves, and as distinct tumors on others; the nerves appeared of irregular size and were indurated, the fibrous tissue being infiltrated among the nerve-fibres. The pneumo-gastric nerve had a tumor the size of an egg upon it. Dr. Smith, of Dublin, in his unrivalled monograph on the subject, has recorded an instance in which many hundreds of such tumors existed; other similar cases might be quoted.

These tumors are not painful, as a rule; indeed, in the most marked examples of this disease, in which the tumors are multiple, they are often not recognizable till after death. Pain, however, is sometimes present, aggravated on pressure, and apparently depending much upon the mode in which the nerve is involved. This affection is not to be confounded with the *painful subcutaneous tumor*.

When the ends of a divided nerve become bulbous from fibrinous effusion, what is called a *traumatic neuroma* is formed. When this becomes involved in the cicatrix of a stump, it is an exceedingly painful affection, and is thought by some surgeons to be more common after flap amputations than others. It must be remembered, however, that all nerve trunks become more or less bulbous after amputation.

Treatment.—There is no reason why neuromata should be removed or touched, unless they are large or painful. When from these causes they require treatment, the operation should be performed, care being observed to dissect the tumor from the nerve, when it is possible, which, however, can rarely be done. Many cases are on record in which large neuromata have been excised with the nerve trunk and a good recovery has followed, even with a restoration of the functions of the divided nerve. Traumatic neuromata should always be excised when causing much pain, but, when associated with symptoms of spinal irritation, which may possibly be due to a neuritis travelling up the affected nerve trunk, the forcible stretching of the nerve has been recommended by Billroth and Nussbaum, and practised by others; but the cases known to me in which it has been tried do not justify me in recommending the practice. It consists in the free exposure of the nerve trunk by incision and the application of forcible traction to it both proximally and distally. The traction has been great, as one author, in describing the operation as applied to the sciatic nerve, says that "the limb of the patient should be lifted from the table by the sciatic nerve."

Painful subcutaneous tumors.—These tumors are clinically to be separated from the neuromata which have just been considered, although they have often doubtless been confused with them. They are not, however, nerve tumors. They were first described by Wood, in the 'Edinburgh Medical Journal' for 1812. They are usually single and situated in the subcutaneous tissue, and are rarely larger than a small bean. They are encysted, and give to the finger a hard elastic touch. To the eye they appear bright yellowish or a pearly white, and are made of fibro-cellular or fibrous tissue. *Intense painfulness* is their clinical peculiarity, although they have no such nerve connection as will explain their excessive sensibility. The pain, says Sir J. Paget, is of the nature of that morbid state of nerve force which we call neuralgia.

The painful character of these tumors is very peculiar. It is not constant, nor does it appear to depend upon any injury, and sometimes comes on without any assignable cause or after only the slightest touch, the pain beginning in the tumor, gradually increasing in intensity and extent till it becomes almost unendurable, darting from the tumor up and down the limb or over the body. The muscles of the limb may likewise be spasmodically affected. The paroxysm may last only a few minutes, or may continue for hours, and subsides as it appears, gradually, leaving the parts tender that were the seat of pain. These painful tumors are most frequent in the female, the neuromata more frequent in the male.

Treatment.—The only treatment is the excision of the growth, which is generally effectual. These tumors rarely recur, although Sir J. Paget has recorded one or two examples of recurrence.

CHAPTER VIII.

DISEASES AND INJURIES OF THE EYE, &c.

By Charles Higgens.

EXAMINATION OF THE EYEBALL AND ITS APPENDAGES.

The examination of the eyeball will be considered under four heads :—

1st. By the unaided eye.
2d. By means of lateral illumination.
3d. By the ophthalmoscope.
    (*a*) Direct examination.
    (*b*) Indirect examination.
4th. By manipulation.

The *refraction* of the eyeball, the field of vision, &c., will also receive a short notice.

I. Examination by the unaided Eye.

In order to examine the outer surface of the eyelids, ocular conjunctiva, cornea, anterior portion of sclerotic, aqueous chamber, and lachrymal apparatus, it is necessary to place the patient in a good light (as before a window), and direct him at first to close the eyes, then open them widely, and look by turns in different directions.

To examine the palpebral conjunctiva it is necessary to evert the upper lid, and to draw the lower one downwards. Eversion of the upper lid can be accomplished thus: The surgeon, standing in front of the patient, should direct him to look downwards and close the eyes; he should then place the forefinger of one hand upon the lid at the attached or upper border of the tarsal cartilage, and make gentle pressure downwards and backwards, so as to cause the free edge of the lid to stand away from the eyeball; then place his thumb beneath the margin of the lid, and make a slight upward movement, at the same time continuing the pressure with the finger; by this means the lid will be made to turn upon itself and become everted; the lid may also be everted by pressing a probe horizontally upon its outer surface, and drawing it upwards by means of the lashes, at the same time making pressure downwards with the probe.

To examine the conjunctiva covering the lower lid, all that is necessary is to place the finger upon the margin of the lid and draw it strongly downwards, when its conjunctival surface will become exposed.

NORMAL APPEARANCES.

The outer surface of the eyelids is covered by soft delicate skin, which is thrown into folds on every contraction of the orbicularis; their free margins are of some thickness. From the outer edge of this free margin project the lashes in two or three rows, those of the upper lid being thicker and longer than those of the lower. The lashes extend along the whole outer edge of each lid, but are much fewer and more delicate in that portion extending from the tear punctum to the inner canthus.

The inner edge of each margin is occupied by the orifices of the Meibomian glands, which are seen as a close set of yellowish points. *The ocular conjunctiva* is smooth, moist, shining, and transparent, allowing the white sclerotic to show plainly through it; a few vessels are generally seen running from the outer and inner canthi towards the cornea, but these are perfectly consistent with a healthy condition of the membrane. The caruncle and semilunar fold occupy the space immediately external to the inner canthus, the former appearing as a small reddish-gray projection, the latter as a well-defined pinkish fold. *The palpebral conjunctiva* is also smooth, moist, shining, and transparent, and appears to have somewhat of a yellowish color from the tarsal cartilage, to which it is closely and evenly united, showing through it. That portion of conjunctiva reflected from the lids to the globe (*Fornix*) appears somewhat thickened and wrinkled, and is slightly more vascular than the ocular and palpebral portions.

Certain parts of the conjunctiva require to be specially examined. The portions next the thickened margin of the lid, the fornix, and about the caruncle, are the most likely situations for the lodgment of a foreign body. That portion covering the attached border of the tarsal cartilage also should be noticed, as it is here that granular ophthalmia manifests itself most plainly.

The cornea is smooth, shining, and perfectly transparent throughout, except in the case of old people, in whom a bluish-white rim (arcus senilis) is often seen occupying more or less of the structure, somewhat within its margin; no bloodvessels are seen on its surface or in its substance.

The anterior portion of the sclerotic is pearly white, or of a pale bluish tint, and shining. It is plainly visible through the transparent conjunctiva covering it; some fine vascular twigs may occasionally be seen traversing it in front of its equatorial region. The aqueous chamber is filled by the aqueous humor, which is transparent, colorless, and of such quantity as to preserve the proper curvature of the cornea without causing tension, or allowing of laxity, and to keep it separated from the iris by a considerable interval.

The iris varies in color in different individuals; it is bright and smooth, presenting in health no appearance of bloodvessels. Its plane is exactly vertical; the pupil, situated somewhat to the inner side of the centre of the iris, is perfectly circular, and dilates and contracts quickly with variations of light.

The examination of the *lachrymal apparatus* gives chiefly negative results; the position of the tear puncta closely in contact with the ocular conjunctiva must be noticed; pressure with the finger over the lachrymal sac causes no escape of fluid through the puncta, neither can the lachrymal gland be felt or seen in a normal condition of the parts.

II. Examination by Lateral Illumination.

By this method all the parts mentioned above are seen more clearly; minute foreign bodies, slight opacities of the cornea, &c., which might be overlooked in examining with the unaided eye, are discovered, and in addition the whole of the lens and the anterior portion of the virtreous can most satisfactorily be looked into.

The method of examination should be as follows: The patient should be seated in a dark room (the pupil having been previously dilated with atropine), and a lamp placed at about two feet distance on the left, and rather in front of his face. The surgeon should stand nearly in front, or rather to the patient's right side, and facing him; he should then take in his right hand a biconvex lens of about two and a half inches' focal length,[1] and with it concentrate the light on the surface of the cornea; with a little manœuvring he will find that he can throw the light through the pupil to a considerable depth into the eye. The patient should be told to look in various directions, so that all parts of the anterior portion of the eye may be examined.

The results obtained by lateral illumination are chiefly negative. The lens in health is perfectly transparent, and in youth is nearly colorless, but some bluish lines showing its division into different segments can be recognized by careful examination. As age advances, these lines become more marked, and the whole lens appears of a bluish gray color, though its transparency is still unaffected.

Behind the lens all appears dark, but any tumor, hemorrhage, &c., occupying the anterior part of the vitreous would be discovered.

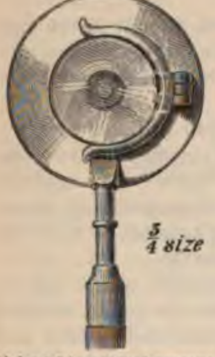
It should be noticed in the examination by lateral illumination that opacities of the cornea, &c., always appear with greatest distinctness on the side which is farthest from the light. A second lens may also be used to magnify the parts illuminated by means of the first.

III. Examination by the Ophthalmoscope.

Description of the instrument.—The ophthalmoscope, as used at the present day, consists essentially of a mirror of silvered glass or polished metal, having a central opening, with certain accessory portions in the shape of convex lenses of different foci, used as objective lenses; clips and other contrivances for holding ocular lenses behind the sight hole of the ophthalmoscope, together with the ocular lenses themselves. The ophthalmoscope since its introduction has undergone innumerable modifications, both in principle and detail; the number of different instruments now in use being nearly, or quite, as great as that of ophthalmic surgeons.

The most useful form of ophthalmoscope is that of Liebreich; the latest modification (Fig. 89) of this instrument consists of a silvered glass concave mirror of about eight inches' focal length, having a central opening in the silvering of a line and a half diameter. The mirror is fixed in a metal back, having a central perforation about double the diameter of the opening in the silvering. Upon the metal back is fixed a clip for the purpose of holding an ocular lens; the back is screwed to a handle about two and a quarter inches long. The accessory portions consist of two object lenses of two and a half and three inches' focal length respectively,[2] and five ocular lenses—two convex, of six and twelve inches positive foci;[3] three concave, of eight, twelve, and twenty-four inches negative foci;[4] all are made to fit into the above-mentioned clip. A very convenient case contains the whole.

Fig. 89.



Liebreich's ophthalmoscope.

Method of using the ophthalmoscope.—There are two methods of using this instrument. The first, which requires much practice, is called the direct method of examination, or examination of the *erect image*, with the ophthalmoscope alone, without the aid of a biconvex object lens.

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[1] A lens of two and a half inches' focal length is about equal to one of sixteen dioptrics in the metrical system (see p. 223).

[2] Sixteen and thirteen dioptrics, metrical system.

[3] About seven and three dioptrics, convex.

[4] About five, three, and one decimal five dioptrics, concave.

The second, which is much the easier of the two, is called the indirect method, or examination of *the inverted image;* in it both the ophthalmoscope and a biconvex lens are used.

Direct ophthalmoscopic examination.—In this method a virtual erect image situated behind the eye is seen. The examination is conducted in the following manner:—

The patient being seated in a dark room, a gas or other lamp (gas being preferable) should be placed at the side corresponding to the examined eye, on a level with it, but so situated as to leave the cornea in shade; he should then be directed to look forwards and a little upwards, at some distant object, and to keep the eyes as steady as possible.

Supposing the right eye to be examined, the lamp should be placed at the patient's right side; the observer, standing in front at a distance of eighteen inches or two feet, should take the ophthalmoscope in his right hand, look through the sight hole with the right eye, and reflect the light from the lamp through the pupil of the patient's right eye. If the examination be conducted properly, the pupil will appear of a bright red color. The observer should then look for the optic disk, which is situated rather to the inner side of the axis of the eyeball; he will know that the disk is in view from the alteration in color of the pupil, which will turn from red to white, or pinkish white. Having obtained the peculiar reflection of the optic disk, the observer (taking care to relax his own accommodation) should approach the eye until an interval of only two inches separates his cornea from that of the examined eye. Some difficulty will be experienced in keeping the eye illuminated, increasing as the distance between the observed and the observer becomes less; this, however, will be overcome by practice. When the observed eye has been approached to within a distance of two to three inches (supposing both the examining and examined eye to be emmetropic), a distinct erect and greatly magnified image of the parts occupying the fundus of the latter should be obtained; most observers will, however, find the image sharpened in outline and detail by using a weak *concave* lens behind the sight hole of the ophthalmoscope. Should either the observer or patient be myopic, it will be found necessary, in order to examine the erect image, to place behind the sight hole of the ophthalmoscope a concave lens, which rather more than neutralizes the existing ametropia.

The examination of the erect image, although requiring considerably more practice than that of the inverted, should never be neglected, as it gives much more satisfactory evidence of minute changes in the fundus oculi, all the parts being seen highly magnified (about 14½ times). It gives, however, a less extensive field of vision, on account of the size of the objects, which only allows small portions of them to be seen through the pupil at one time.

The optic disk, retinal vessels, and other parts occupying the fundus, should be examined by looking in different directions through the pupil; the observed eye being kept steadily fixed during the examination upon some distant and suitably situated object.

The right eye having been examined, the lamp should be placed on the patient's left side, and the manœuvre repeated; the observer using the left hand and left eye, instead of the right hand and right eye. The condition of refraction of the eye can be diagnosed by the direct method of examination. (*See* p. 224.)

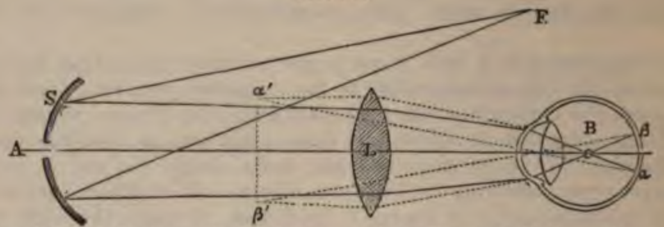
Indirect ophthalmoscopic examination.—In this method of examination an inverted aerial image of the fundus oculi is formed by the interposition of a biconvex lens between the observer and observed eye. (*See* Fig. 90.)

The position of the patient and observer should be the same as for the direct examination; the same lamp also can be used, but should be placed rather further back and kept on the patient's left side during the examination of either eye. The ophthalmoscope should be held in the same manner and the light reflected through the pupil as detailed above; but the red reflection having been obtained, the observer must not approach the eye, but remain at a distance of about eighteen inches.

The patient should be directed to look at some distant object so situated that the axis of the observed eye is turned somewhat inwards; this brings the optic disk (which lies somewhat to the inner side of the optic axis) opposite the ophthalmoscope, and its peculiar bright reflection will be at once observed.

The biconvex lens should then be held in front of the observed eye at a distance about equal to its own focal length from the cornea, and steadied by the observer resting his ring and little fingers on the patient's brow. By this means an inverted image of the optic disk and vessels of the retina is immediately seen, which, although apparently within the eye, is in reality formed in the air between the observer and the biconvex lens, and (in emmetropia) at a distance from the latter corresponding to its focal length.

Fig. 90.



From Carter's translation of 'Zander on the Ophthalmoscope.' A, Observer's, B, observed eye. F, The light. S, The mirror. L, the biconvex lens. α β, Some portion of the retina, or the disk. α′ β′, Its inverted aerial image formed between the mirror and biconvex lens.

If the image of the disk appear indistinct, the observer may be sure that his own eye is not accommodated for the distance at which the image is situated, which is, in reality, shorter by some inches than it appears to be. Should this be the case, the observer must increase the tension of his accommodation, or withdraw somewhat further from the observed eye.

A better method, however, than either of the foregoing, is to employ habitually, behind the sight hole of the ophthalmoscope, a convex ocular lens of about ten or twelve inches'[1] focal length. If this is done, a clear and well-defined image will always be obtained without tension of accommodation, provided precautions be taken that the distance between the observer's eye and the image be *not greater than the focal length of the convex ocular lens.*

The disk and parts immediately surrounding having been examined, the patient should be directed to look straight forward, so as to bring the region of the yellow spot opposite the ophthalmoscope; this having been carefully examined, the eye should be turned upwards, downwards, to the right and left, so that all parts of the fundus may be examined in turn.

In the indirect method of examination the observer should use his right eye, and hold the ophthalmoscope in his right hand and the biconvex lens in his left in examination of the right eye, and *vice versâ* in examination of the left.

Difficulties of Ophthalmoscopic Examination.

Considerable practice is required in order to become proficient in the use of the ophthalmoscope; the beginner will be frequently much disheartened at his want of success. Some of the difficulties are only to be overcome by practice, others are easily remedied. Reflections of the mirror from the two surfaces of the object lens often prove very troublesome; the inconvenience arising from this source is obviated by holding the lens somewhat obliquely, when the two images will recede from each other and leave a clear space between them. Reflection from the surface of the cornea may be troublesome, but can usually be overcome by a little manœuvring. Contraction of the pupil is also an insurmountable obstacle to the beginner, but can be removed by dilatation with atropine; for this purpose a solution of one grain to one ounce of water should be dropped into the eye about half an hour before the examination is made; or the patient may be ordered to use a solution of one-eighth grain to one ounce two or three times on the day preceding it. When experience has been gained, however, atropine can be dispensed with, except in some few cases, or in those where it is necessary to make a very careful examination by lateral illumination.

If the patient be directed to look at a distant object the accommodation is relaxed, and sufficient increase in the pupillary area will generally take place.

Every ophthalmoscopic examination should be conducted on a certain definite system.

The first step should be to examine the condition of the refractive media by lateral illumination.

Next, the condition of refraction of the eye and the state of the vitreous chamber should be ascertained by the direct method of examination.

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[1] Four or three dioptrics.

Thirdly, a general survey of the fundus oculi should be made by the indirect method.

And fourthly, any abnormalities having been discovered by the indirect examination ould be fully and carefully studied in detail by the direct method.

If this systematic plan of examination be carefully carried out few mistakes will be ade, and no abnormality of importance is likely to be overlooked.

NORMAL APPEARANCE OF PARTS SEEN BY THE OPHTHALMOSCOPE.

The refractive media (cornea, aqueous humor, lens, and vitreous), as stated under Lateral Illumination, are perfectly transparent.

The retina is either quite transparent and colorless, or in dark eyes may appear as a faintly gray cloud, covering the choroid; its position is marked by that of its bloodvessels. The bright red reflection previously mentioned is due to the blood in the choroid; the depth in color of the reflection varies with the amount of pigmentation of this vascular tunic—in blue or gray eyes it is light red, in dark ones of a much deeper tint, and in the negro appears to be dark blue. The parts of the fundus oculi requiring special attention are the optic disk and parts immediately surrounding it, and the region of the yellow spot.

The disk appears at first sight to be of an uniform pale pink color, but on closer examination different portions are found to present different shades.

Its centre is pale, or even white; next to this succeeds a zone of pink, this being again bounded by an apparently double border of lighter color. The pale appearance of the central portion of the disk is caused by connective tissue surrounding the bloodvessels in this situation. The succeeding pink zone consists entirely of nerve-fibres and delicate capillaries. The outer pale double border is formed by the margins of the sclerotic and choroidal rings, which do not accurately cover each other, the choroidal ring being somewhat greater in diameter than the sclerotic opening, the margin of which, being left uncovered by pigment, shines through the transparent nerve-fibres.

Both the white central portion and the outer ring are in some cases so distinctly marked that the appearance produced might be taken by an inexperienced observer as evidence of disease, but both conditions are perfectly consistent with health. From the pale central portion of the disk proceed the retinal bloodvessels; these appear upon its surface usually at the same point, but may emerge separately or in groups of two or three.

As a rule about eight vessels are seen, upon or close to the disk, four of these being arteries, with a corresponding number of veins; two of each pass upwards and a like number downwards, to be distributed over the retina. The lateral branches are comparatively insignificant, and are given off from the principal trunks, either upon the nerve surface or in the retina near its margin.

The veins are distinguished from the arteries by being of greater calibre, the proportion being about three to two. There is also a difference in color between the two, the veins being the darker; the arteries are marked by a double contour, and their central portion is much lighter than their borders.

Occasionally a dark spot is noticed in one of the vessels at its origin or termination in the disk. This might be taken for a clot, but the appearance is caused by a peculiar arrangement of the vessel, which at this point is seen, as it were, on end and foreshortened.

Spontaneous pulsation of some of the retinal *veins* may also be observed; the occurrence of *venous* pulsation is, however, perfectly consistent with health, and has no pathological import.

In any eye, pulsation, both arterial and venous, can be produced by pressure upon the globe, but should it occur spontaneously in the *arteries* has the gravest significance. (*See* Glaucoma.)

ANOMALIES OF OPTIC DISK, &c., CONSISTENT WITH HEALTH.

Certain phenomena are not unfrequently observed with the ophthalmoscope, which, although contrary to the condition usually met with, are perfectly consistent with a normal state of the parts.

The appearances caused by the connective tissue surrounding the central vessels, the occurrence of pulsation, unusual distribution, and existence of dark spots in the latter, together with the unusual distinctness of the sclerotic ring, have been already mentioned.

Other anomalies are—

1. *A dark crescentic* figure bordering some portion of the margin of the disk. This appearance is caused by a peculiar arrangement of the choroidal pigment; it is congenital.

2. *Variations in depth of color of the disk* are frequently met with. Due regard must be had to the color of the surrounding fundus in forming an opinion as to whether the tint in any particular case is so much deepened or lessened as to constitute a diseased condition.

In light eyes the disk appears much redder than in dark, the apparent difference being due more to contrast with the surrounding parts than to actual change in color.

Slight deviations are only to be determined by careful examination and long experience.

3. *Excavation of the optic disk.*—Not unfrequently a sloping or even abrupt depression is met with occupying the centre of the disk, but usually extending somewhat further towards the yellow spot than in other directions. The whole nerve surface, however, is never included in the cup; the vessels do not bend under its edge, their calibre is not altered, neither is spontaneous arterial pulsation observed, as may be the case in the excavation of glaucoma. (*See* Glaucoma.)

4. *Persistence of the hyaloid artery.*—Occasionally a small whitish cord may be seen extending from the centre of the disk to the back of the lens; it is the remains of a vessel which, during fœtal life, nourished the latter structure.

5. *Senile changes.*—As age advances, the refractive media become less transparent, the retina grows somewhat hazy, and the disk appears whiter than natural.

6. *An appearance of white wisp-like patches*, extending from some part of the margin of the disk over the surrounding fundus. These patches have irregular jagged borders, and are often of considerable size; the retinal vessels pass through and are obscured by them. Occasionally white threads may be continued for a considerable distance along the sides of the vessels.

The patches are caused by the opaque nerve-sheaths which should end at the lamina cribosa, being accidentally continued beyond this point into the transparent retina; they are congenital, and do not interfere with vision.

7. The choroidal vessels are at times (especially in light eyes) very plainly visible appearing as an irregular network of pale pink bands.

The region of the yellow spot presents in health no very marked ophthalmoscopic signs, but requires special notice, as it is frequently the seat of pathological lesions. In the normal condition it is recognized by the absence of bloodvessels, which appear to avoid this part of the retina, and pass above and below it; by some deepening in color, and occasionally an indistinct, dark, transversely oval figure can be detected.

IV. Examination by Manipulation.

The fourth method of examination, *by manipulation*, consists simply in ascertaining the tension of the globe by digital pressure. The examination should be conducted as follows:

The patient being directed to look downwards and close the eye gently, but not to screw up the lids, the surgeon should make gentle alternate pressure with the forefinger of each hand placed upon the closed upper lid; the pressure should be made in a direction backwards and somewhat downwards, so as to compress the globe against the floor of the orbit.

In health the eyeball is firm, tense, and semi-fluctuating; in disease the tension may deviate in the direction of increase or decrease. The degree of tension may be expressed as follows:

If normal, as Tn; if above par, as T + 1, T + 2, T + 3, according to the amount of increase; if below par, as T — 1, T — 2, T — 3. If a doubt exist, as T + ? or T — ?, according as the doubt is on the side of increase or decrease.

REFRACTION, ACCOMMODATION, ACUTENESS, AND FIELD OF VISION.

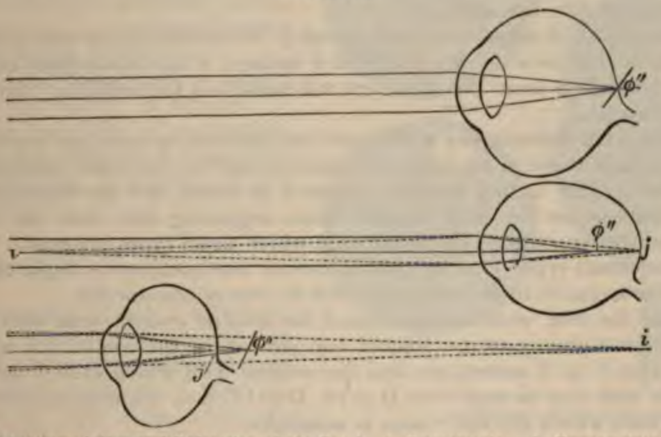
Definition.—By refraction of the eye we understand the power which the refractive media (cornea, humors, and lens) possess by virtue of their curvatures and densities of bringing together *parallel* rays of light, and forming them into an image at a certain spot known as the principal focus of the refractive or dioptric system), *without the employment of any adjusting power.*

The refraction is said to be *normal* or *abnormal* according to the position of the retina with regard to the focus of the dioptric system. The former condition is known as *emmetropia*, the latter as *ametropia*, the terms normal and abnormal being seldom applied.

Emmetropia.—The emmetropic eye (Fig. 91 *a*) is of such a shape that the retina is situated at the focus of the *dioptric system*, and in such a position that a distinct and inverted image of any object (*the rays of light proceeding from which are parallel*) is formed upon the layer of rods and cones.

Ametropia.—The ametropic eye differs from the emmetropic in two opposite directions; the deviations are known as *anomalies of refraction*. In the first and (in this country)[1] most commonly met with anomaly the retina lies *within* the focus of the dioptric system; that is to say, the axis of the eyeball is too short from before backwards; and images of objects, the rays of light proceeding from which are parallel, are formed behind the retina instead of in its substance. This anomaly is known as *hypermetropia*, or far sight (*see* Fig. 91, *b*).

Fig. 91.[2]



From Donders, 'Accommodation and Refraction of the Eye.' *a.* Emmetropia. *b.* Hypermetropia. *c.* Myopia.

To the second anomaly an opposite state of things pertains; the axis of the eyeball from before backwards is too long, consequently the retina comes to lie outside the focus of the dioptric system, and the image of an object, the rays of light coming from which are parallel, is formed in front of it. This anomaly is known as *myopia*, or short sight (*see* Fig. 91, *c*).

The diagnosis of anomalies of refraction can be made by trial with lenses, or by *direct* ophthalmoscopic examination. If we wish to diagnose and measure the degree of anomalies of refraction by trial with lenses we must be provided with a set of trial glasses and a book of Snellen's test types (see p. 226).

The trial glasses, which are now coming very generally into use, are arranged according to what is known as the "metrical system." The unit in this system is a lens of one metre focal length; it is called a "dioptric" (=D). A lens of two dioptrics is double the strength of that of one dioptric, and has a focal length of half a metre (fifty centimetres), and so on. The box of trial glasses contains convex and concave spherical and cylindrical lenses. It can be obtained from any good optician.

We test refraction with lenses as follows:—Having placed our patient at 6 metres from the sheet on which are printed letters from D = 6[3] to D = 60, we direct him to look towards it. Should he be hypermetropic he will be able to make out all or most of the letters; he will already have told us that he cannot see to do near work or read for any length of time without the eyes becoming fatigued and vision growing misty. We ascertain how many of the letters can be read by each eye separately. Should both eyes read the same letters, we hold before them convex glasses, beginning with $+1$ D, and continue the trial until we have ascertained *the strongest convex* lens with which the greatest attainable acuteness of vision is still maintained. Thus, supposing our patient reads $D=6$ at 6 metres, we find the strongest convex lens with which he can still read $D=6$; should he read $D=12$ without a convex lens, and $D=6$ by the aid of one, we find the strongest with which he can still read $D=6$; if we cannot improve vision, so that he reads more than $D=12$, we find the strongest convex glass with which he can still read $D=12$, and so on. Should there be a difference between the two eyes, we must test the refraction of each separately, keeping one covered during the trial of the other. The strongest convex lens which still allows the patient to see as well at a distance as is possible, either with or without the aid of glasses, shows a part of the accommodative power which he was obliged to exercise in order to bring parallel rays of light to a focus upon the retina of his too short eye. The employment of such a lens prevents this waste of accommodation, and reserves it, to be used when required for near work.

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[1] It is generally believed amongst English, and is also reported by continental ophthalmologists, that in this country hypermetropia is of more frequent occurrence than myopia. It appears to me that the reverse may obtain. We are rarely in hospital practice consulted about slight myopia, as it gives no inconvenience. On the other hand, a very slight degree of hypermetropia may incapacitate the sempstress, skilled mechanic, or clerk, so that whereas we get all degrees of hypermetropia, we are only applied to in the higher degrees of myopia.

[2] In these diagrams φ'' shows posterior focal points of the dioptric system—*j* in *b* and *c* the abnormal position of the retina.

[3] The smaller letters D = 5, D = 4, D = 3, &c., placed at their proper distances, will do equally well if we have not a distance of 6 metres at disposal.

Should our patient be myopic, he will probably tell us that he is near-sighted; he will make out but few or none of the letters at 6 metres; if the small types be given him to read, he will hold them near the eyes, but will make out the smallest, provided the book be held close enough.

We notice at what distance the small types can be read by each eye separately, and, as in hypermetropia, if there be no difference between the two test their refraction together.

We tell our patient to look towards the sheet on which are the letters from $D=6$ to $D=60$, and hold before his eyes concave lenses beginning with that the negative focal length of which corresponds to the distance at which small types are read.

Thus, if the small types can be read at twenty centimetres, we begin the trial with a lens of 5 D, the negative focal length of which is twenty centimetres.

We continue the trial until we have found the *weakest concave* lens with which distant letters can be most plainly seen. Should our patient by the aid of any concave lens be able to read $D=6$ at 6 metres, we find the *weakest* with which $D=6$ can still be read. Should he be able only to make out $D=24$, $D=12$, &c., we must still find the weakest concave lens with which the best vision is attainable.

As in hypermetropia, should there be a difference between the two eyes, we test each eye separately.

We must be careful to ascertain *the weakest* lens with which the best vision for distant letters is attainable, because we wish only to so open out the pencil of parallel rays of light as to allow of their being brought to a focus in the retina of the too long eyeball.

If we give too strong a lens our patient will see equally well; but then we have opened out the pencil of parallel rays too much, and he must use his accommodative power in order to overcome the excessive divergence.

In the diagnosis and measurement of anomalies of refraction by direct ophthalmoscopic examination we act upon the same principles as in the diagnosis by trial with lenses; with this exception, however, that we use our own eye as a test, instead of the patient's vision.

As stated at p. 219, nothing of the details of the fundus of the emmetropic eye can be *clearly* made out until we have approached it very near. Now, on the contrary, should any object occupying the fundus be *clearly seen*, whilst we are still separated from the observed eye by a considerable interval, we may be certain that we have to deal with an anomaly of refraction.

The question now arises, Is the case one of hypermetropia or myopia? We answer the question by ascertaining whether the object we see is viewed in an erect or inverted position. If the former, the eye is hypermetropic, if the latter, it is myopic. We can ascertain the position of the image by moving our head from side to side. If the image be erect, it will move in the same, if inverted, in an opposite, direction to the movements of the head.

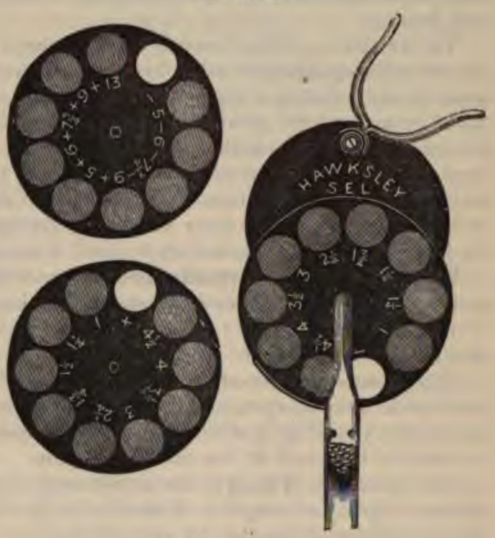
If we wish to ascertain the amount of hypermetropia or myopia present, we take one of the ophthalmoscopes mentioned below; go as close as possible to the patient's eye, revolve the lens containing disks placed at the back of the instrument until we have ascertained, in hypermetropia, the strongest convex, in myopia, the weakest concave, lens with which we can still see clearly the optic disk and retinal vessels.

The number of dioptrics of the strongest convex or weakest concave lens with which the greatest attainable acuteness of vision *for distant letters* is still maintained, expresses what is known as the degree of "ametropia." Thus, we say that an eye which sees as clearly or more clearly through a convex lens of two dioptrics has a hypermetropia of 2 D, an eye of which the acuteness of vision is most improved by a concave of lens of three dioptrics has a myopia of 3 D, and so on.

The same holds good in the measurement of anomalies of refraction by the ophthalmoscope. The strongest convex lens in a case of hypermetropia, the weakest concave in one of myopia, through which a clear view of the fundus can still be obtained, expresses the degree of "ametropia" present.

Two very useful ophthalmoscopes, by means of which anomalies of refraction cannot only be diagnosed, but also accurately measured, have been devised, one (Fig. 92) by Mr. Charles J. Oldham, of Brighton (*see* 'Report of Fourth Ophthalmic Congress,' 1872), and another by Mr. W. L. Purves; the latter is, I think, the more convenient of the two.[1]

Fig. 92.



Oldham's ophthalmoscope.

The TREATMENT of anomalies of refraction consists mainly in neutralizing the defect by suitable spherical lenses. We must, however, in myopia take care not to give too strong glasses.

For further information on the subject of refraction the reader is referred to works treating specially of ophthalmic subjects, more especially to that on 'The Accommodation and Refraction of the Eye' (Donders).

ACCOMMODATION.

By accommodation is meant the power which the eye possesses of altering the condition of its refractive media, so as to form upon the retina images of near objects, the rays of light from which are divergent, equally as distinct as images of more distant ones, the rays of light from which are parallel, or nearly so.

The power of accommodation depends upon the elasticity of the crystalline lens, the curvature of which can be increased to a considerable extent; the alteration of curvature is brought about by the action of a ring of inorganic muscular fibres, situated between the sclerotic and choroid, just external to the greater circumference of the iris. This ring is known as the *ciliary muscle*. The manner in which the ciliary muscle acts upon the lens is as yet a disputed point, one theory being that the lens is maintained in a flattened condition by tension of its suspensory ligament so long as the eye is adjusted for a distant object; that upon accommodation for a near one the ligament is relaxed by contraction of the muscle, and the curvature of the lens (more especially that of its anterior surface) increased by virtue of its own elasticity. The other theory is that the ciliary muscle compresses the lens in some manner, and so alters its curvature.

RANGE OF ACCOMMODATION.

We speak of the range of accommodation, and by it we mean the power of a lens, which we suppose the crystalline adds to itself, when we change our look from the farthest to the nearest point of distinct vision Thus, an eye which sees clearly at infinite distance, when its accommodation is relaxed, and at 16 centimetres with greatest tension of accommodation, has a range or "amplitude" of accommodation equal to a lens of $\frac{100}{16} = 6$ D about.

Accommodation is accompanied by convergence of the optic axes from the action of the internal recti muscles and by contraction of the pupil.

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[1] Many other refraction ophthalmoscopes are in use, but the two mentioned and another smaller and cheaper instrument, known as Loring's ophthalmoscope, will be found as useful as any.

DISEASES OF ACCOMMODATION.

Paralysis of accommodation is met with in cases of paralysis of the third nerve, accompanied by ptosis, divergent strabismus, and more or less dilatation of the pupil; it may be caused by injuries, as blows on the eyeball itself or in its vicinity; sometimes it is met with without apparent cause, not unfrequently in persons recovering from diphtheria, or from any exhausting disease, and accompanied by no paralysis of the external ocular muscles; it can always be produced artificially by the use of atropine.

Symptoms.—Dilatation of the pupil, general mistiness of vision, and inability to see near objects plainly, the last condition being capable of correction by the use of a convex lens.

TREATMENT.—This depends on the cause; if the paralysis of accommodation be associated with paralysis of other branches of the third nerve, the treatment must be directed against any existing constitutional condition—syphilis, rheumatism, &c.—most improvement being brought about by the use of iodide of potassium in increasing doses, alone or in conjunction with bichloride of mercury. If dependent on injury, the eye should be kept bound up, and inflammatory symptoms treated as they arise. If arising idiopathically, without apparent cause, Calabar bean[1] should be used two or three times a week, in order to stimulate the ciliary muscle to contract, and attention paid to the general health. In any case a convex lens may be used if required.

Spasm of accommodation is met with in some cases of hypermetropia, and occasionally in myopia; it often masks a considerable amount of hypermetropia, and may at times even make the eye appear to be myopic. If it exists with myopia, the degree of short sight is increased.

Symptoms.—Severe and constant pain in the eyeballs and forehead, increased on any attempt to use the eyes, and associated with some anomaly of refraction (generally hypermetropia), inability to see near or distant objects distinctly, these symptoms being modified or entirely removed by the use of atropine.

TREATMENT.—Paralyze the accommodation by the constant use of a strong solution of atropine (gr. iv of sulphate of atropia to ℥j of water), and accurately neutralize any existing anomaly of refraction by suitable lenses.

ACUTENESS OF VISION.

By acuteness of vision we understand the perceptive and conductive power of the structures concerned in sight; this may be ascertained by the use of test types; *i. e.*, letters of certain definite proportions, which can be recognized by a fairly sharp-sighted eye at certain distances, which distances are marked over each set of letters.

The book of test types we use is that of Dr. Snellen; in it we find types variously numbered from .5 to 60, the former being .5 of a metre, or 50 centimetres, the latter 60 metres, at which distances the types can be read by an emmetropic eye of normally acute vision. The book of types can be obtained of Williams and Norgate, Henrietta Street, Covent Garden.

FIELD OF VISION.

By the field of vision we understand the area over which objects situated in the same vertical plane can be distinguished, the eye being kept fixed on some point. The limits of the field of vision are marked by the most excentrically placed points of objects, which can still be distinguished, the direction of the visual axis of the eye being unaltered.

Mode of ascertaining the extent of the visual field.—The extent of the visual field is easily measured by either of the two following methods:—

1. The patient being placed at a distance of twelve inches from a black board about three feet square, having a white cross in its centre, should be directed to look steadily at the cross, which must be situated on a level with the eyes; one eye being closed, the sensibility of the retina of the other should be tested by moving a piece of chalk fixed on a dark handle from all directions towards the cross, a mark being made at the point where the chalk first becomes visible.

The whole area limited excentrically by a line joining the points at which the chalk is first seen when approaching from every direction is known as the *quantitative field* of vision, in contra-distinction to an area bounded excentrically by much narrower limits, over which objects are distinctly defined, and letters can be read, &c., known as *the qualitative field of vision.*

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[1] The Calabar gelatine was the most convenient form for application, but recently a solution gr. iv to ℥j of sulphate of esserine (an alkaloid obtained from Calabar bean) has been employed with the best results.

2. Another very simple and effectual method of investigating the condition of the visual field is conducted as follows:—

Having placed the patient in a convenient position, we stand opposite to him, at a distance of about two feet, and, supposing his left eye to be examined, we direct him to look steadily at our right eye, which is opposite to his left; the patient's right eye and our left being kept closed, we then move our hand in various directions in the peripheral parts of the field, and notice if its movements are perceived by the patient at the same distance from the centre as by our own healthy retina.

Care must be taken that the hand is moved in a vertical plane situated midway between our own and the patient's eye, and not nearer one than the other; we must also take care that he keeps his eye fixed.

Supposing that the eye under examination distinguishes all movements of the hand at the same distance from the centre as our own, we decide that his field of vision is normal; but if a falling off is noticed in any particular direction, we infer that the sensibility of the corresponding portion of retina is impaired.

It must be remembered that each part of the visual field corresponds to a part of the retina opposite to, and not on the same side as, the object seen; *e. g.*, suppose that the movements of the hand are not perceived in the outer half of the field, the inner half of the retina is defective, and *vice versâ.*

It must also be borne in mind that the height of the bridge of the nose has a considerable influence in limiting the inner half of the visual field. Limitation or contraction of the visual field is a very constant accompaniment of retinal changes; it is also one of the earliest symptoms of glaucoma, and occurs as a physiological condition with advancing age.

Stereoscopic tests for the retina.—A very simple and effectual method of testing the sensibility of the retina has been devised by Mr. Joseph Towne, of Guy's Hospital: it consists in presenting simultaneously to non-corresponding halves of the two retinæ similar objects.

The examination is carried out by means of a stereoscope, provided with two slides; on each slide are two white semicircles described upon a red ground, those on the one slide being so contrived that when looked at through the stereoscope they correspond to the nasal halves of the two retinæ, whilst those on the other slide correspond to the two malar halves. In cases of want of sensibility of the whole or any part of the retina, from whatever cause arising, a part or the whole of one or both semicircles corresponding to the affected portion of retina appears misty or entirely obscured. The degree and extent of the mistiness or obscurity is governed by the degree of insensibility and extent of the impaired portion of retina. Mr. Towne has made "The Stereoscopic Test for the Retina" the subject of some very interesting papers in 'Guy's Hospital Reports,' series iii, vols. xi, xii, xiv, xv.

DISEASES AND INJURIES OF THE EYEBALL AND ITS APPENDAGES.

Several of the more important affections of the organ of vision will be briefly alluded to in future pages; the present section is devoted to a short description of those diseases and injuries which (with a few exceptions, *e. g.*, glaucoma) do not call for operative interference.

THE EYELIDS.

Congenital anomalies.—Absence of the eyelids; a failure of closure of the fœtal fissure, leaving a cleft in one or both lids (coloboma); ptosis, complete or partial; development of a third lid; pigment spots, moles, nævi, and warty growths, have all been occasionally met with.

Ulcers.—Simple ulcers, venereal sores (chancres), syphilitic, and cancerous ulceration, are sometimes met with. The first three require to be treated on general medical principles; the last by operation, if the disease has not proceeded too far.

Phthiriasis.—The pediculus pubis (crab louse) is sometimes found amongst the eyelashes close to the margin of the lids. The edges of the lids appear to be covered with scabs and crusts somewhat resembling tinea; on close examination the insects themselves will be discovered adhering closely to the margin of the lids, their eggs being attached to the lashes near their bases.

TREATMENT.—The daily use of some kind of mercurial preparation, none being better than the Ung. Hydrarg. Ammoniatum.

Paralysis of the obicularis muscle occurs in some cases of facial paralysis; there is inability to close the eye, the lower lid falls away from the globe, there is considerable collection of lachrymal secretion at the inner canthus, and constant watering of the eye consequent on the displacement of the lower tear punctum.

TREATMENT.—General medical treatment should be adopted.

Spasm of the orbicularis muscle may occur from long-continued intolerance of light, consequent on affections of the cornea.

TREATMENT must be directed against the corneal affection. (*See* Diseases of the Cornea.)

Spontaneous twitching, more especially of the lower lid, popularly known as "live blood," is met with in some cases of hypermetropia, or in persons whose digestions are out of order; it is very probably a symptom of undue contraction of the ciliary muscle.

TREATMENT.—Correction of existing hypermetropia, instillation of atropine, and attention to the general health.

Inflammation of the eyelids may occur during or after acute diseases (measles, scarlatina, &c.), in the course of erysipelas, as the result of injuries, or in connection with severe inflammation of neighboring parts, *e. g.*, purulent ophthalmia. The swelling and redness are usually considerable, and the eye cannot be opened; the inflammation generally ends in resolution, but may (especially if it result from measles, scarlatina, &c.) go on to the formation of abscess, or even to the sloughing of the skin.

TREATMENT.—Locally, fomentations with hot water or decoction of poppy heads; if an abscess form, it should be opened—preferably through the conjunctiva.

The patient's general health should also be attended to.

Stye ("hordeolum") is a small red and painful swelling situated on the outer surface of the lid, or near its margin, and consists in a circumscribed inflammation of the lid, dependent on morbid change in the Meibomian glands. Styes generally occur in weakly delicate persons; several may appear simultaneously, or there may be a succession of them; they give rise to considerable irritation, and are often extremely painful. The inflammation usually goes on to suppuration.

TREATMENT.—Fomentations, poultices, the administration of tonics, and good living. When pus has formed, the little tumors should be opened.

Tinea (ophthalmia tarsi).

Patients suffering from tinea present themselves with yellowish-brown dry crusts hanging to the eyelashes, which have often dropped out to a considerable extent.

In old cases the margins of the lids are much thickened, giving rise to displacement of the tear puncta and consequent watering of the eye; on removing the crusts the margin of the lid will be found ulcerated, fissured, and easily bleeding. The disease consists in inflammation and ulceration about the roots of the lashes; it runs a very chronic course, often lasting for years in spite of remedies.

TREATMENT.—Slight cases can generally be cured by the use of a lotion containing 4 to 6 grains of alum to the ounce of water, applied three or four times a day, and of mild nitrate of mercury ointment (one part of the ordinary nitrate of mercury ointment to eleven of lard),[1] smeared along the margins of the lids night and morning.

The patient should be directed to remove all the crusts before applying the ointment.

More severe cases should be treated by pulling out the lashes and removing the scabs with forceps, and then applying solid nitrate of silver to the raw surface left.

Injuries.—Wounds of the eyelids, however extensive and ragged, should, after having been thoroughly cleansed, be brought accurately together; they will usually heal readily enough. Should there be any loss of substance, an endeavor must be made to prevent distortion of the lids by contraction of the resulting cicatrix.

Ecchymosis of the lids (black eye) frequently occurs as the result of blows, and may be caused by leech bites or operations.

TREATMENT.—Most cases may be left alone, but if it is desirable to get quickly rid of the effused blood, a poultice made of equal parts of the scraped root of black bryony and bread crums should be applied. The poultice should be kept on as long as the patient can bear it. The application is often accompanied by a good deal of stinging pain.

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[1] The ointments employed in the ophthalmic department at Guy's Hospital are now almost invariably prepared with vaseline instead of lard.

Emphysema of the lids sometimes occurs from rupture of the mucous membrane of the nose, air being forced into the cellular tissue of the eyelids, on sneezing, or blowing the nose. Gentle pressure with cotton wool and a bandage, and avoidance of violent expiratory movements, sneezing, &c., is the only treatment required.

The lachrymal apparatus.—The principal affections of the tear passages, &c., will be described in the next section.

THE CONJUNCTIVA.

Ophthalmia.—Under this head are collected all the different forms of inflammation of the conjunctiva. The following characters are common to all; more or less vascularity of the membrane, uneasiness and stiffness of the lids, pain of a smarting character, some kind of discharge, and gumming together of the lids during sleep.

Inflammation of the conjunctiva has to be distinguished from inflammation of the sclerotic or subconjunctival fascia, or the injection of these structures which is present in many of the inflammations of deeper parts of the globe. The distinction can be made by paying attention to the following points:—

1. The inflamed conjunctiva is bright red, the vessels are large and tortuous, and anastomose freely, forming a dense network; they are of greater calibre about the fornix, and taper off towards the cornea.

The inflamed sclerotic or episcleral tissue is pinkish or bluish in color; the vessels are small and straight, and the vascularity is usually most marked in a ring around the eyeball, just external to the corneal margin.

2. The vessels of the conjunctiva can be somewhat displaced, and made to glide over the surface of the eyeball by gentle pressure; those situated in deeper parts cannot be made to alter their positions.

3. The pain in inflammation of the conjunctiva is of a smarting character; while in inflammation of deeper parts it is dull and aching, and often very severe.

TREATMENT.—Inflammations of the conjunctiva are best treated by astringent applications.

Any of the following formulæ may be employed:—

Strong Alum Lotion.
Alum, gr. x; water, ℥j.
Useful in cases of purulent ophthalmia.

Alum Lotion.
Alum, grs. iv to vj; Water, ℥j.

Sulphate of Copper Drops.
Sulphate of copper, gr. ij; Water, ℥j.

Sulphate of Zinc Drops.
Sulphate of zinc, gr. ij; Water, ℥j.

Nitrate of Silver Drops.
Nitrate of silver, gr. j; Water, ℥j.

Chloride of Zinc Drops.
Chloride of zinc, gr. ij; Water, ℥j.
Most useful in cases of chronic ophthalmia.

Atropine and Astringent Solution.
Sulphate of atropia, gr. ½ to gr. ij; Sulphate or chloride of zinc, gr. ij; Water, ℥j.
Useful in cases where iritis or corneitis occurs in the course of ophthalmia.

Any of these remedies may be given to the patient to use himself; they should be applied from three to six times a day, or oftener, and the patient should be directed to wash away all discharge before using any of them, and to take care that the lotion goes well between the lids.

Some kind of ointment (spermaceti, mild nitrate of mercury, &c.) should also be ordered to be smeared on the margins of the lids at night, to prevent their becoming gummed together during sleep.

The condition of the patient's general health should also be attended to.

Other applications, which should be used by the surgeon himself are—

The mitigated nitrate of silver stick (consisting of nitrate of potash and nitrate of silver, in the proportion of three parts of the former to one of the latter).—*Green stone—lapis divinus* (consisting of equal parts of alum, nitrate of potash, and sulphate of copper, with a small quantity of camphor), and *solid nitrate of silver*. In order to apply any of these the patient should be seated in a chair, and the surgeon standing behind, as in Fig. 93, p. 250; should evert the lids and lightly rub their conjunctival surface with either. If a prepaaation of nitrate of silver be employed, the conjunctiva should be washed with salt and water immediately after the application.

VARIETIES OF OPHTHALMIA.

Catarrhal ophthalmia is commonly caused by draughts of cold air, is highly contagious and acute in its course.

The conjunctiva, both ocular and palpebral, is highly injected, and sometimes swollen; there may be small extravasations of blood in the structure of the former; there is a thick, yellow, tenacious discharge.

One or both eyes may be affected, the disease usually commencing in one, and spreading to the other in the course of two or three days.

TREATMENT in the early stages, before there is any amount of discharge.—Some soothing application (as decoction of poppy-heads) should be employed; later on, an astringent should be used, and some mild nitrate of mercury or spermaceti ointment smeared on the edges of the lids at bedtime, to prevent their becoming gummed together during sleep.

The patient (or, in the case of a child, its parents) should be warned of the contagious nature of the disease, and no sponges, towels, &c., which he is in the habit of using, should be used by other people. Among the poorer classes it is very common to see a whole family suffering from catarrhal ophthalmia.

Chronic ophthalmia is usually a sequel of some more acute form; the palpebral conjunctiva is reddened, the ocular conjunctiva presenting patches of slightly increased vascularity, but no general redness, as in cases of catarrhal ophthalmia; the lids are often somewhat thickened, and the caruncle and semilunar fold swollen. There is slight mucous discharge, which forms dry crusts on the margins of the lids, and, at the inner canthus, overflow of tears may occur from obstruction or displacement of the tear puncta.

TREATMENT, the same as that of catarrhal ophthalmia. The disease may continue for almost any time, and when one remedy appears to have lost its effect another should be tried.

Phlyctenular ophthalmia, usually met with in children and young adults, especially females, is characterized by the existence of small whitish elevations on the conjunctiva, most commonly near the margin of the cornea; each little elevation has a wisp of bloodvessels leading to it if near the corneal margin, and is surrounded by a zone of vascularity if situated in any other part of the conjunctiva. There is some watering of the eye and slight mucous discharge.

Patients are frequently met with who suffer from repeated attacks of phlyctenular ophthalmia.

TREATMENT.—In treating phlyctenular ophthalmia our object is to set up a certain amount of irritation of the conjunctiva, by which the phlyctenulæ will be destroyed. This can be attained by dusting calomel into the eye daily, or by ordering a small quantity of an ointment containing 2 grs. of yellow oxide of mercury to ʒj of lard or vaseline, to be applied to the inner surface of the lower lid at bedtime. Either of these remedies will soon cause the phlyctenulæ to disappear. The disease, as affecting the conjunctiva covering the cornea, will be spoken of under diseases of that structure. Tonics should be given if required.

Granular ophthalmia.—This disease occurs at all ages, and is very common amongst the lower classes, especially the Irish; it is highly contagious. Granular ophthalmia is often very prevalent where large numbers of persons are crowded together in workhouses, parish schools, barracks, &c. It would appear that in those who have lived for a considerable time under unfavorable hygienic conditions, a peculiar granular state of the palpebral conjunctiva becomes developed. Persons thus affected are said to be predisposed to granular ophthalmia. The predisposed eyelid is characterized by the existence of small pale spherical bodies, situated in the structure of the conjunctiva; the little bodies much resemble and are know as sago grains; they are most constantly found upon the lower lid near the outer canthus.

This predisposed or granular condition of the eyelids may remain stationary for an limited time without giving rise to inconvenience; but on the other hand, attacks of flammation are ever liable to be set up, giving rise to the development of granular ophalmia as we see it in practice.

We meet with three principal forms of granular ophthalmia, which may be distinguished om each other by the nature of the granulations present.

One characterized by the predominance of the sago grains already alluded to, around hich inflammation has been set up, is known as follicular granulation.

Another form, characterized by the predominance of hypertrophied papillæ, by which he sago grains if they exist are obscured, is known as papillary granulation. A third orm, characterized by a mixture of follicular granulations and hypertrophied papillæ, is nown as mixed granulation; this is the most severe form of the three.

In old cases, and especially those that have been treated by strong caustics, the con-unctiva may be found converted into a mass of rough harsh cicatrices, and its secreting power destroyed, the condition known as "xerophthalmia" being developed.

Granulations in active granular ophthalmia, unlike the sago grains which characterize the predisposed lid, are always found most developed on the conjunctiva covering the attached border of the tarsal cartilage of the upper lid. Their appearance is more or less altered by treatment; they are accompanied by thick yellow discharge, and there may be more or less severe intolerance of light.

Sequelæ of granular ophthalmia.—The cornea may become more or less opaque and vascular, especially at its upper part; the condition is known as "pannus," and is caused by constant irritation of the cornea by the rough surface of the lid.

The conjunctiva may be destroyed to a greater or less degree, extensive cicatrices being formed, which, by their contraction, cause shrinking of the membrane and distortion of the lids, giving rise to entropion and narrowing of the palpebral aperture. The hair bulbs may become displaced, causing the eyelashes to be misdirected—"trichiasis" (see p. 253). The results of granular ophthalmia are frequently aggravated by unskilful treatment.

TREATMENT.—In treating granular ophthalmia our object is to destroy the granulations, with as little damage as possible to the conjunctiva itself.

The use of strong caustics must be carefully avoided, as they cause too much destruction of tissue, followed by the formation and subsequent contraction of cicatrices.

Slight cases can be cured in a short time by the application of mitigated nitrate of silver stick twice a week, or oftener, and the use of sulphate of copper drops from three to six times a day.

More severe cases will remain under treatment for months or years, but if persevered with will usually get well. If the ophthalmia be of recent date the granulations should be touched twice a week with the mitigated nitrate of silver stick, or, if possible, every day, sulphate of copper drops being used from three to six times daily.

In chronic cases the green stone should be used instead of the nitrate of silver stick.

The application of calomel powder or quinine to the granulations has also been found useful in some cases.

When the cornea is completely opaque and fleshy looking, inoculation with pus from a case of purulent ophthalmia may be tried, but only in extreme cases, otherwise we may do more harm than good by causing sloughing of the cornea; should but one eye be affected, care must be taken to prevent the other becoming inoculated.

Iritis not unfrequently supervenes in the course of granular ophthalmia; when it occurs a solution of atropine should be dropped into the eye from three to six times daily, in addition to other remedies.

Pannus requires no special treatment, and if not very dense disappears as the granulations are cured. In all cases some simple ointment should be applied to the edges of the lids at night, to prevent their becoming gummed together.

Purulent ophthalmia.—Purulent ophthalmia may be met with, as "ophthalmia neonatorum" in children soon after birth, or in older persons. In the former case it may e caused by contact of acrid vaginal secretions, by want of cleanliness and fresh air, or a ombination of the two; in the latter by contact with some form of specific pus, or by onstant irritation of the already inflamed conjunctiva. It is highly contagious.

The worst form of the disease, whether occurring in infants or older persons, is that aused by inoculation with gonorrhœal matter—"gonorrhœal ophthalmia."

"Ophthalmia neonatorum" makes its appearance a few days after birth; the eyelids re found red or bluish-red and swollen; the eyes can only be opened with difficulty, and on attempting to separate the lids thick yellow purulent discharge escapes from between their edges; both eyes are almost always affected.

Purulent ophthalmia in older persons may affect one or both eyes; it commences with intolerance of light, lachrymation, and injection of the conjunctiva, at first much resembling an ordinary attack of catarrhal ophthalmia, but in about twelve hours its real nature becomes apparent by thick yellow discharge from between the swollen red, and sometimes everted lids. The conjunctiva is bright scarlet, traversed by large distended bloodvessels, and much swollen, especially the ocular portion (chemosis), which may overlap the cornea and protrude in folds between the lids; there is pain and intolerance of light; and there may be much depression, especially if the attack have lasted long. The patient may be suffering from gonorrhœa. The great danger to be feared in purulent ophthalmia is implication of the cornea, which may be partially or entirely destroyed by suppuration or sloughing.

TREATMENT.—In all cases the patients themselves or their parents should be warned of the contagious nature of the disease, and if one eye only be affected the greatest care should be taken to protect the other. If possible, a good view of the cornea should be obtained, as its condition materially influences the prognosis with regard to sight. The examination should be made with care, as the cornea may be ruptured whilst making it.

In ophthalmia neonatorum the only treatment is to wash out the eyes every hour or half hour with strong alum lotion (see p. 229) until the discharge is lessened; the lotion need only be used thus frequently for twelve hours out of twenty-four (from 8 A. M. to 8 P. M.), the child being allowed to sleep at night; as the discharge gets less the lotion may be used less frequently. Some simple ointment should be applied to the margins of the lids once or twice a day to keep them from sticking together.

Slight cases of purulent ophthalmia in older persons may be treated in the same manner, but the more severe forms (especially the gonorrhœal) require that much more energetic measures be taken.

The treatment should be both local and constitutional.

Local treatment.—When the patient is first seen the lids should be everted, and the whole conjunctiva brushed over with a stick of solid nitrate of silver, or painted with a solution of 40 to 60 grains of the salt to ℥j of water; the application should be repeated in the course of two or three days if no improvement have taken place. The patient should be kept lying down in a dark room, and a bag of ice, or lint kept wetted with iced water, applied over the closed lids; the ice or lint should be removed and the eyes washed out every hour or half hour with some astringent lotion, the greatest cleanliness being observed.

Should there be much pain, and the patient be strong, blood may be taken from the temples by leeches or the application of the artificial leech, but, as before stated, most patients suffering from severe purulent ophthalmia are much depressed and will not bear depletion.

Constitutional treatment.—The free administration of tonics, especially iron and quinine, with good living, and a fair amount of stimulants.

If perforation of the cornea threaten or have taken place, the eye should be kept firmly bandaged, so as to prevent as much as possible any escape of the contents of the globe.

Diphtheritic ophthalmia.—This form of ophthalmia is but rarely met with in London; it affects persons of all ages. At first sight the case appears to be one of severe purulent ophthalmia; its chief characteristic, however, is a solid infiltration of the substance of the conjunctiva, with or without the formation of diphtheritic membranes on its surface. The affected eye is frequently lost from implication of the cornea. The disease is best treated by sedative applications, as fomentations of poppy heads, or belladonna, attention being paid to the patient's general health.

Injuries.—Wounds of the conjunctiva usually heal readily enough, requiring only simple treatment.

Burns are usually caused by contact of lime or hot metals; the damage done may be only slight, or the whole conjunctiva and cornea may be converted into a dead white slough.

TREATMENT.—The conjunctiva should be carefully examined, and all foreign bodies and portions of sloughy tissue removed; should the injury have been caused by lime the surface of the conjunctiva must be carefully cleansed with a weak solution of acetic acid or simple warm water. Some oil should be placed between the lids, and the eye bound up with wet lint and a bandage. If any symptoms of iritis appear, a solution of atropine should be dropped into the eye from three to six times a day. Should there be much discharge alum lotion may be used.

When the sloughs have separated care must be taken to prevent adhesions between the raw surfaces left, by passing a probe between the lids and eyeball once or twice a day, and directing the patient to draw the lid away from the globe frequently.

Foreign bodies, small pieces of coal, iron, &c., are sometimes found embedded in the conjunctiva, and must be removed.

Hemorrhage into the substance of the conjunctiva or beneath it may occur spontaneously, or from injury; no treatment is necessary; the patient may be assured that no harm will come of it, and that the blood will disappear in the course of a week or longer.

EXTERNAL MUSCLES OF THE EYEBALL.

Strabismus will be considered in the next section.

Nystagmus signifies a peculiar involuntary quivering motion of both eyes, dependent on rapid contraction of antagonistic pairs of muscles. The disease is usually developed in infancy, and is always associated with considerable impairment of vision, arising from congenital cataract, opacity of the cornea after purulent ophthalmia, atrophy of choroid, &c.

TREATMENT.—Nothing can be done to remedy nystagmus.

Paralysis and paresis.—Paralysis signifies total loss of power of the affected muscle; paresis, only partial loss.

The symptoms of paralysis and paresis are double vision and total loss, or impairment of mobility of the eye in some particular direction.

The causes are affections of the brain or spinal cord; diseases within the orbit, as tumors, or inflammatory affections, pressing on the nerves supplying the muscles, and affections of the nerves themselves or of the muscles. As a rule, the cause of the paralysis or paresis can only be conjectured, but very many cases will be found connected with syphilitic diseases.

TREATMENT.—A careful inquiry should be made into the patient's previous history, and remedies given in accordance with this, those of an antisyphilitic nature being generally required. If the affection has not existed more than three months a favorable prognosis may be given, but if, on the contrary, it has existed six months or more recovery is very improbable.

Insufficiency of the internal recti muscles gives rise to somewhat obscure symptoms, which have been mistaken for manifestations of cerebral disease.

Patients thus affected complain that they cannot do near work for any length of time, as objects looked at become indistinct, or appear double. They suffer from giddiness, and pain in the brows and head generally. Insufficiency of the internal recti should always be suspected if in a case of hypermetrophia relief cannot be given by the use of glasses.

TREATMENT.—Any anomaly of refraction should be accurately neutralized, and the weakened muscles assisted by the use of the prisms or of spherical lenses so arranged as to have a prismatic action.

THE CORNEA.

Inflammation (corneitis, or keratitis).—Five different forms of inflammation of the cornea are met with:—(1) Simple corneitis, (2) interstitial or parenchymatous corneitis, (3) pustular corneitis, (4) keratitis punctata, (5) corneitis with sloughing or suppuration.

Symptoms.—Corneitis is characterized by watering of the eye, impairment of vision, intolerance of light, and pain, at times severe, at others insignificant; on examination more or less of the cornea will be found cloudy or quite opaque, and bloodvessels may be seen in its substance or on its surface.

It is of importance to notice the course and position of the bloodvessels in any case where the cornea has become vascular. Should the vessels lie altogether in the cornea, commencing near its margin, and passing for a variable distance in its substance, the case is probably one of interstitial keratitis; but should the vessels be continuous with those of the conjunctiva, pass over the margin of the cornea, and lie superficially on its surface, the vascularity is probably due to mechanical irritation from granular lids or inverted lashes, and the condition known as *pannus* is present.

It is very necessary that the difference between these two forms of vascularity should be recognized, as their treatment varies widely.

In the former case the treatment of keratitis, to be presently described, should be adopted; in the latter treatment must be directed against the cause of the vascularity (granular lids, &c.).

Simple corneitis may be caused by injuries, or the lodgment of foreign bodies on the surface or in the substance of the cornea. There is some pain, intolerance of light, and lachrymation, and some part of the cornea is found occupied by a halo of dulness.

Interstitial or parenchymatous keratitis (corneo-iritis, syphilitic keratitis, keratitis, diffuse keratitis, vascular corneitis).

Interstitial keratitis occurs in persons who are affected by hereditary syphilis; it is frequently but by no means invariably associated by changes in the teeth, pegged canines, notched incisors, or dome shape of first molars; flattened nose, fissures around the angles of the mouth, or other manifestations of congenital syphilitic disease.

It usually first makes its appearance between the fifth and eighteenth years, but has been seen as late as thirty; it always affects both eyes either simultaneously or at short intervals; it runs a very chronic course, and is most intractable, a severe attack often lasting from twelve to eighteen months.

Symptoms.—Interstitial keratitis presents all the symptoms of inflammation of the cornea in a marked degree. The opacity is peculiar, and is caused by infiltration of the substance of the cornea with opaque material.

At first the cornea becomes spotted in its centre, but the spots soon run together, forming a grayish haze; opacity then commences at the upper and lower corneal margins, and gradually spreads, until the whole structure resembles somewhat a piece of ground glass, apparently blood-stained in parts, from the development of innumerable minute bloodvessels. There is always a well-marked band of ciliary injection. Interstitial keratitis is not unfrequently complicated by iritis, hence the name "corneo-iritis."

The opacity having reached a certain point, may remain stationary for months, but at length clearing commences, and the cornea regains more or less of its normal transparency; recovery always taking place to a much greater extent than would be at first expected. In some few cases a choroido-iritis is set up, and the eye eventually shrinks.

Pustular corneitis (phlyctenular, strumous, vascular, corneitis; strumous ophthalmia, fascicular keratitis).

Pustular corneitis is met with in children and young adults; it often follows measles, scarlatina, or other acute diseases; it is frequently accompanied by eczematous eruptions on the eyelids, about the nostrils and angles of the mouth, and on the head; the patients often present well-marked strumous diatheses, and are generally said to be delicate.

Symptoms.—In most cases there is profuse lachrymation, accompanied by great intolerance of light; the lids may be swollen, covered with eczematous eruption, and tightly screwed up, so as to cause the greatest difficulty in examination.

There is more or less injection of the ciliary region (ciliary redness). Upon the surface of the cornea may be found (1) small grayish elevations (phlyctenulæ); (2) phlyctenulæ in a state of suppuration (pustules); (3) small ulcers left on discharge of the contents of the latter. Any of these are usually found in greatest quantity round the margin of the cornea, but its whole surface may be found dotted over with phlyctenulæ, pustules or ulcers, or examples of all three may be met with in the same eye. There is more or less haziness and vascularity surrounding the affected portions of cornea. In some cases there is thick mucous or muco-purulent discharge in addition to the lachrymation.

Cases of pustular corneitis, accompanied by great intolerance of light, much swelling of the eyelids, profuse lachrymation, and thick muco-purulent discharge, occurring in strumous children, are sometimes described as a separate disease under the name of "strumous ophthalmia."

Fascicular keratitis is a somewhat rare form of the disease characterized by the existence of a fasciculus of vessels running on to the cornea from its margin, the fasciculus terminating in a small ulcer, phlyctenula, pustule, or small inflamed patch of cornea.

Pustular corneitis is very likely to recur.

Keratitis punctata occurs in young adults, never in children; it much resembles the early stages of interstitial keratitis, and probably arises from the same cause; as a rule, one eye only is affected; there are the usual symptoms of corneitis, but the intolerance of light is not very severe; the cornea is dotted over with small grayish opacities, which are collected most thickly in its central portion, and on careful examination will be found to occupy the posterior layers of the structure. The disease is most intractable, and may be accompanied by iritis.

Corneitis with sloughing or suppuration is usually the result of sharp blows, flicks from twigs, &c., or is caused by the irritation of foreign bodies, as the husks of rn ; it may also occur after operations for cataract.

Symptoms.—Those of corneitis, severe pain being, as a rule, one of the most marked ; me part of the cornea will be found occupied by a collection of pus, part of which may ave escaped into the anterior chamber and collected at its lower part, giving rise to the ondition known as "hypopyon ;" or the pus may have gravitated down between the layers f the cornea to its lower margin, forming a collection much resembling hypopyon and nown as "onyx." Suppurative corneitis is met with in cases of *neuro-paralytic phthalmia;* a peculiar form of inflammation, associated with paralysis of the ophthalmic division of the fifth nerve, and consequent anæsthesia of the parts supplied by it.

Instead of a collection of pus, some part of the cornea may be found occupied by a dead white slough, or a large ulcerated and sloughing surface.

The iris may also be inflamed and suppurating.

Treatment.—The treatment of corneitis should be both local and constitutional.

Local treatment.—All foreign bodies or other sources of irritation should be removed ; the eyes must be protected from light by a large shade, protectors, or better still by a bandage. Sedative applications should be employed, none being better than belladonna lotion, containing from 6 to 10 gr. of extract of belladonna to the ounce of water ; or, if preferred, a weak solution of atropine, gr. ½ to a pint of water, may be used instead ; the eyes should be bathed three or four times a day with either of these, and kept bound up with lint wetted with one or the other.

If iritis exist, a stronger solution of atropine, gr. ½ to gr. ij or iv to the ounce of water, should be dropped into the eyes as often as may appear necessary.

In corneitis with suppuration warm applications will be found most beneficial ; the eye should be well bathed with warm belladonna lotion or decoction of poppies several times a day, and bound up firmly with lint, soaked in one or the other. If pain be a prominent symptom it may be greatly relieved by taking blood from the temples. Should a large area of the cornea become infiltrated with pus, a free incision should be made by transfixing with a cataract knife and cutting out obliquely through the centre of the infiltrated portion.

In cases of corneitis, especially of the interstitial and pustular forms, where there is obstinate intolerance of light, which will not yield to the above treatment, a seton should be placed in the skin of the temple on one or both sides (*see* p. 252). In some cases the spasmodic contraction of the orbicularis may be kept up by the irritation of small fissures at the outer canthus ; in such a free division of the junction of the lids and orbicularis by cutting through the canthus will often effect a speedy cure.

The inhalation of chloroform is also said to act beneficially in some cases.

If in a case of suppuration or sloughing perforation of the cornea appear imminent, iridectomy should be performed.

Constitutional treatment.—Simple corneitis requires no constitutional treatment. In the interstitial form antisyphilitic remedies should be employed ; to older patients the bichloride of mercury in doses of one-sixteenth to one-twelfth of a grain, combined with bark or other tonic, should be given twice or three times a day ; to young children hyd. cum cret. gr. j to v three times a day.

The other forms of corneitis, especially the pustular, are best treated by the administration of tonics, as steel wine, tincture of perchloride of iron, quinine, &c. ; and in strumous children cod-liver oil should also be prescribed, with good living and plenty of fresh air.

Ulcers of the cornea present a great variety of forms. They may be transparent or opaque ; they may be healing, indolent, vascular, or sloughing. The depth to which the corneal tissue is destroyed varies from slight abrasion of its surface to destruction of its whole thickness, causing perforation. The area of the cornea which is destroyed also varies from a small point to its whole surface.

Ulcers are sometimes described as marginal or central, according to their position. Ulceration of the cornea is constantly met with in cases of debility, from whatever cause rising. It is very common in patients recovering from acute diseases, as measles, carlatina, and more especially smallpox, from impaired nutrition, not from formation of ustules or eruption on the cornea. Children are much more frequently affected than adults.

The symptoms of ulceration are very similar to those of corneitis. On examination ny kind of ulceration may be found (one variety has been mentioned under Pustular orneitis). There may be one or more small *transparent ulcers,* which can only be seen in certain lights, and are very likely to be overlooked. They appear like small abrasions of the epithelium; sometimes the greater part of the surface of the cornea is found to be affected either by several small transparent ulcers or one large one. This form of ulceration is most commonly met with in adults of irritable, nervous temperament, and should always be carefully looked for when a patient of this description presents himself suffering from severe intolerance of light, watering of the eye, and smarting pain, without any very apparent cause.

Opaque ulcers are visible enough; they may be of any size or number. At times they appear to be healing, in which case the edges appear smooth and the surface of the ulcer rough and opaque or cloudy. At others they are indolent, and again they may be spreading, when their edges are found to be clean cut, as if a piece of the cornea had been punched out by some sharp instrument; the surface of the ulcer appears glassy, and is often deeply excavated.

Sloughing ulcer is more or less opaque, spreads rapidly, both in area and depth, and if the process be not soon arrested the cornea will be perforated, and a prolapse of the iris of greater or less extent (according to the size of the perforation) will take place. If the opening be large the lens or some of the vitreous may escape.

In the greater number of cases of perforation of the cornea the iris pushes forward, fills the opening, and becomes adherent to its margins, forming an "anterior synechia," but a considerable prolapse may take place, forming a projection or bulge from the surface of the cornea—"staphyloma."

Marginal or crescentic ulcer (ulcus corniæ serpens) is a somewhat peculiar form of corneal ulceration; it is met with in persons of middle age, is very intractable, and very liable to recur or relapse. This form of ulceration is accompanied by very severe pain, great intolerance of light, and very profuse lachrymation. On examination a crescentic patch of ulceration is found skirting generally the upper margin of the cornea; the ulcer is deep, its margin clean cut, and the surface glassy looking.

The ulceration spreads rapidly up to a certain point—remains stationary for a time, and then commences to heal slowly, the healing process being frequently interrupted by relapses.

The ulcerative process may involve both the upper and lower segments of the cornea, but never passes up to its centre.

TREATMENT.—The treatment of ulcers of the cornea is similar to that of corneitis, but in all cases it is better to keep the eye carefully bandaged. Iridectomy should be performed in any case should perforation be imminent.

Opacities of the cornea are the result of inflammation, ulceration, or injury.

They are met with of all densities and sizes; thin cloudy opacities are known as "nebulæ," dense white ones as "leucomata." A dense white opacity, involving the whole cornea, is called a "total leucoma;" an opacity of the same description occupying a part only, a "partial leucoma." Should a corneal opacity have been caused by a perforating ulcer or wound of the cornea, an "anterior synechia" will probably be found associated with it.

False Pterigium.—*Fleshy opacities* are sometimes met with near the margin of the cornea, and continuous with the conjunctiva. They are composed of granulation tissue, and are frequently the result of burns.

TREATMENT.—Corneal opacities have always a tendency to disappear, especially in children. Their removal may be aided by the use of slightly irritating applications, which set up a certain amount of increased vascularity, and thus aid absorption. The remedies generally employed are drops of sulphate of copper, iodide of potassium, or opium; turpentine, pure, or mixed in various proportions with olive oil; calomel powder, or the yellow oxide of mercury ointment. Any of these may be used for some considerable time. Should no improvement have taken place at the end of two or three months, and the opacity be so situated as to interfere with vision, an artificial pupil must be made, and if the opacity be disfiguring it should be tinted. The fleshy opacities may be removed by operation, but are very liable to reappear in their former site.

Injuries.—Abrasions of the cornea may be caused by scratches from thorns, ends of straw, finger nails, &c. They give rise to severe pain, much intolerance of light, and watering of the eye.

TREATMENT.—The eye should be kept carefully bandaged with lint soaked in belladonna lotion till the abrasion has healed.

Penetrating wounds of the cornea generally involve the iris or lens; in the former case an adhesion of the iris to the cornea (anterior synechia) is likely to be formed, or itis set up; in the latter the lens will probably become opaque, a traumatic cataract being eveloped.

Very extensive wounds of the cornea may allow the escape of the lens or vitreous.

Treatment.—The eye should be kept carefully bound up with lint soaked in bellaonna lotion, and in cases where the lens has been wounded, or iritis set up, a solution of tropine, one grain to one ounce of water, should be dropped into the eye from four to six r eight times daily.

Should the lens swell and cause pain and increase of tension, it must be removed without delay, or iridectomy must be performed.

Iridectomy may have to be performed at some future time for optical reasons, or to obviate the irritation caused by dragging on an anterior synechia. Traumatic cataract may also require to be treated.

Burns of the cornea by lime, hot metals, &c., usually occur in conjunction with like injuries of the conjunctiva; they usually leave behind them opacities of greater or less extent and density, according to the severity of the injury, or may cause sloughing and destruction of the whole or greater part of the cornea.

Treatment, the same as that of burns of the conjunctiva.

THE SCLEROTIC AND EPISCLERAL TISSUE.

Inflammation of the sclerotic or episcleral tissue, or more commonly of both together is a somewhat rare disease; it is characterized by the presence of purple swollen patches, covered by enlarged conjunctival vessels, and situated usually about the insertion of the recti muscles.

The purple patches often disappear from one portion of the globe, and appear again at another; the inflammation is chronic in its course, but subsides after a time, leaving some discoloration of the affected part; it is very liable to recur.

It occasionally follows operations for strabismus.

Treatment.—Sedative applications, as decoction of poppy-heads, or belladonna fomentation, should be used three or four times a day, and if there be much conjunctival vascularity or any mucous discharge some astringent lotion, as chloride of zinc drops (see Formulæ, p. 229) should also be employed.

Any constitutional treatment that may appear called for should be adopted. In some cases tonics do most good; others, again, may be greatly benefited by a course of mercury or iodide of potassium.

This disease is usually described as "episcleritis."

Staphyloma.—A bulge of the sclerotic may occur from softening of its structure by inflammatory changes, which usually commence in the choroid.

Staphyloma may be met with in the ciliary region (ciliary staphyloma), about the equator (equatorial staphyloma), or near the optic nerve (posterior staphyloma). Little can be done in the way of treatment.

Injuries.—The sclerotic may be wounded by sharp instruments, or ruptured by blows; in the latter case the lesion usually takes place in the ciliary region, near the upper margin of the cornea.

The sclerotic (as also the cornea) may be pierced by a shot or chip of metal, which may be lodged within the globe or have passed clean through it.

Treatment.—The treatment of injuries of the sclerotic depends much upon the extent and nature of the damage done.

Small incised wounds will usually heal readily enough if the eye be kept carefully bandaged. Larger wounds may require to be closed by a suture.

Blows often cause complete disorganization of the globe, the aqueous and vitreous chambers being filled with blood, and hemorrhage having taken place between the sclerotic and choroid, although no rupture of the external tunic has occurred.

Such cases must be carefully watched, and the eye kept bandaged with lint soaked in belladonna lotion.

In cases of extensive incised wounds, large ruptures, or wounds associated with lodgment of a foreign body within the globe, extirpation of the eyeball will probably have to be performed.

THE CRYSTALLINE LENS.

Congenital anomalies.—Variations in shape, absence of the whole (Aphakia) or part of the lens, and displacements, are met with as congenital defects.

Presbyopia (old sight).—Presbyopia depends on senile change of the crystalline lens, by which it is rendered harder than in youth and its elasticity is impaired. As a consequence its curvature can only be altered to a limited extent by the action of the ciliary muscle, and the power or range of accommodation is correspondingly diminished.

Persons generally begin to experience the effects of presbyopia about the age of forty-five. The nearest point of distinct vision, which year by year has been receding from the eyes, now becomes inconveniently far off, so that small print can only be read with difficulty or not all; distant vision, however, still remains acute.

It has been arbitrarily decided that a person shall be considered presbyopic as soon as his nearest point of distinct vision comes to stand at twenty-two centimetres or further from the eyes, and the degree of presbyopia is expressed by the number of dioptrics (D) which it is necessary to give the eye in order to bring its near point up to this distance; or, in other words, to give it a refractive power equal to 4.5 D, which is the power of the lens which the crystalline must add to itself in order to see distinctly at twenty-two centimetres. Thus, a person aged forty-five can only see distinctly at twenty-eight centimetres, that is, he can only add to his crystalline a lens equal to 3.5 D. In order to enable him to see distinctly at twenty-two centimetres we must give a lens which makes up the difference between 3.5 D and 4.5 D, *i. e.*, 1 D. A person of forty-five, therefore, requires a convex lens of 1 D to remedy his presbyopia; the number of this lens also expresses the degree of presbyopia.

It has been determined by observation that presbyopia increases by one dioptric for every period of 5 years from 40 to 60; sometimes by one dioptric and sometimes by a half only, for each similar period from 60 to 80.

The following table shows the lens required at each period of five years by the emmetropic eye. Should hypermetropia exist its degree must be ascertained and added to the number given in the table. The degree of myopia, on the contrary, must be subtracted:—

Age.	Dioptrics.	Age.	Dioptrics.
40	0	65	4.5
45	1	70	5.5
50	2	75	6
55	3	80	7
60	4		

Should our patient require to see at some particular distance, the numbers in the table need not be adhered to; he may be allowed to select those lenses which he thinks suit best. As a matter of fact we often find that the glasses given in the table are too strong, especially in hypermetropic persons who have become presbyopic before taking to glasses. Such persons have long been accustomed to strain their accommodation to the utmost, and will not thank us for giving them glasses which neutralize the whole of their hypermetropia as well as their presbyopia. We shall give much greater satisfaction by ordering glasses which a little more than neutralize the hypermetropia, and so give a little help without being an absolute correction.

Injuries.—Opacity of the lens (traumatic cataract) may be caused either by penetrating wounds of the cornea or simply by concussion.

Dislocation of the lens.—As a result of blows upon the eyeball, the lens may become partially or entirely displaced; it may still retain its transparency, but often becomes more or less opaque.

Displacement of the lens may take place upwards or downwards, laterally forwards into the anterior chamber, backwards into the vitreous, or it may be entirely extruded from the globe through a wound in the sclerotic, and lie beneath the conjunctiva. In the three first positions the displacement is only partial and the margin of the lens can be seen by oblique illumination occupying some part of the pupil.

In displacement forwards the pupil will be found dilated, irregular in shape, and fixed; oblique illumination will show the lens lying partially or entirely in the anterior chamber.

In displacement backwards the iris will be tremulous, the pupil sluggish, and the anterior chamber deepened. Direct ophthalmoscopic examination will probably detect the lens lying in the ciliary region at the lower part of the eye.

In displacement beneath the conjunctiva the lens is found forming a small rounded tumor, somewhere near the corneal margin, most frequently at its upper part.

TREATMENT.—If the lens be displaced partially or into the anterior chamber, and still retain its transparency, it may be left alone. But should it become opaque or appear to be setting up irritation, it should be removed by extraction, preferably associated with iridectomy. A transparent lens may remain for years in the anterior chamber, and, with the exception of impairment of vision, give rise to no inconvenience. If its capsule has been lacerated, however, it will become opaque, and if not extracted will gradually be removed by absorption.

A lens displaced into the vitreous chamber will very probably act as a foreign body, and set up glaucomatous changes, in which case it should be removed at all risks; but if it produces no irritation is best left alone.

A lens displaced beneath the conjunctiva may also be left to itself.

Cataract will be considered in the section on operations.

THE IRIS AND CHOROID.

Congenital anomalies.—**Coloboma** signifies a cleft condition of the iris or choroid, dependent on failure of closure of the fœtal fissure. In the iris it occurs as a deficiency of the lower segment, appearing as if iridectomy had been performed downwards. In the choroid it is seen (on examination with the ophthalmoscope) as a brilliant white figure, commencing at the optic disk, and continuing downwards and forwards for a variable distance towards the ciliary processes, through which, in extreme cases, the cleft may extend, and be even continuous with a similar deficiency of the iris.

In the **Albino** the pigment of the iris and choroid is absent to a greater or less extent, and with the ophthalmoscope the fundus of the eye appears of a yellowish-white color.

Iridermia, or congenital absence of the iris, is occasionally observed.

Persistence of the pupillary membrane.—Small portions of the membrane which at a period of fœtal life covered the pupil occasionally remain, and may be seen as one or more fine threads, somewhat resembling cobwebs, passing across the pupillary area, and attached at either end to the anterior surface of the iris, near the margin of the pupil.

Anomalies of color.—The iris of one eye may be brown, that of its fellow being blue, or differences in color may occur in different parts of the same iris.

Tremulous iris (iridodonesis) signifies a tremulous condition of the iris, which shakes about as the eye is moved. This condition is met with when the iris has lost the support of the crystalline lens, when the vitreous humor is abnormally fluid, or the iris totally paralyzed.

The term *paralysis* should, strictly speaking, be applied only to cases where the iris is tremulous, all its proper movements being destroyed and the pupil of moderate size; but it is often used in the condition of dilatation of the pupil met with in some cases of paralysis of the third nerve; in which, however, only the circular fibres are affected.

Mydriasis signifies abnormal dilatation of the pupil; **Myosis,** abnormal contraction.

Tumors seldom originate in the iris itself, but its structure often becomes implicated by growths commencing in deeper parts of the globe (*see* Tumors of Eyeball); instances, however, of malignant growths, dermoid and simple cysts, and of the cysticercus, have been met with in the iris.

INFLAMMATION OF THE IRIS (IRITIS).

Causes.

Local.—Irritation from foreign bodies in the conjunctival sac or cornea; friction of the cornea by granular lids or inverted lashes; injuries to the iris itself by operations, or accidents, with or without the lodgment of foreign bodies in its substance or on its surface; pressure by a swollen crystalline lens, and exposure from perforation of the cornea.

Constitutional.—Debility, after acute disease, over-lactation, &c.; certain specific diseases, as syphilis, rheumatism, and gout.

Symptoms.—The following symptoms are met with in most cases of iritis: changes of color, cloudiness and loss of polish of the iris, sluggishness or complete immobility and (as a rule) contraction of the pupil, injection of the ciliary region (ciliary redness), watering of the eye, and impairment of vision. Other symptoms met with occasionally are pain, intolerance of light, irregularity in outline of the pupil, inflammatory products—pus or lymph nodules—visible to the naked eye.

Three **varieties** of iritis are commonly met with. 1. Simple iritis. 2. Recurrent or rheumatic iritis. 3. Syphilitic iritis.

Simple iritis.—All the more constant symptoms of iritis are present, often accompanied by more or less severe pain. An uncomplicated attack lasts from one to two weeks or longer, and usually ends in resolution, the iris quite recovering its normal condition, but a few adhesions may form between the iris and lens-capsule (posterior synechiæ). In this as well as in the other forms of iritis, however, the inflammation may run on to the formation of a considerable quantity of new material or into suppuration.

Recurrent or rheumatic iritis occurs in persons who are subject to attacks of rheumatism or gout, and also in the children of rheumatic or gouty parents; an attack of this form of inflammation presents all the more constant symptoms of iritis, and has one character peculiar to itself, viz., its tendency to recur, some patients having had as many as twenty or more separate attacks; in some cases the attacks observe a remarkable periodicity, recurring regularly at the same time of year. The inflammation sometimes appears in one eye, sometimes in the other, or perhaps in both, rarely, however, simultaneously, but at short intervals, the second eye becoming affected long before the first has begun to recover. Recurrent iritis is frequently accompanied by more or less haziness of the cornea and aqueous humor. In some cases very severe pain of a dull aching character is experienced in the eyeball, forehead, side of nose, and temple; in others the attack is most insidious, the patient's attention not being attracted until a considerable amount of new material has been thrown out, extensive adhesions formed, the sight of one eye much impaired, and the inflammatory action extended to the other. The great feature of this form of iritis is its tendency to recur. The cause of the recurrences is not very evident; they are probably due primarily to "posterior synechiæ," and are prevented by the performance of iridectomy.

All persons, however, who have "posterior synechiæ" are not subject to recurrent iritis; so that in all probability in those who are liable to repeated attacks there is a tendency to the lighting up of inflammation upon very slight provocation, such as the dragging of posterior synechiæ.

Syphilitic iritis is, perhaps, the most common of all the forms.

A typical case presents all the constant symptoms of iritis in a very marked degree, the zone of ciliary redness being extremely well defined. There may be, besides, certain peculiar nodular excrescences, of a dirty yellow color (known as lymph-nodules), situated on the surface of the iris or at its pupillary margin, and at times extending into the pupil, which may be completely blocked by them. These excrescences are syphilitic gummata, and their existence renders the diagnosis of syphilitic iritis certain; they are, however, only occasionally present, and in the greater number of cases met with the surgeon will have to take into consideration the patient's previous history, ascertain the existence of other signs of syphilis, and make his diagnosis accordingly.

Syphilitic iritis occurs most frequently between the ages of fifteen and forty, but is occasionally met with as a manifestation of congenital syphilis in infants.

Results of Iritis.—In many cases, especially if early and properly treated, perfect recovery takes place; in others permanent signs of inflammation are left. The morbid changes more commonly met with are—

(1) The iris itself may be found *atrophied*, *rigid*, or *rotten*, and very prone to bleed freely on the slightest wound. These conditions become most apparent when operating upon its structure. On attempting to perform iridectomy considerable difficulty will be experienced in removing a portion of the iris, which may be so tough that none of it can be torn away, or so rotten that only the portion included between the branches of the forceps is removed, or hemorrhage may take place to such an extent as to prevent the completion of the operation.

(2) *Adhesions to neighboring parts* ("*synechiæ*") may have formed, those most commonly met with being between the iris and lens-capsule ("posterior synechiæ").

Posterior synechiæ are generally situated at the pupillary margin, and vary in extent from a few adherent tags, of this part only, to complete adhesion of the whole posterior surface of the iris to the lens-capsule, this latter condition being known as "total posterior synechia."

Adhesion of the iris to the cornea, "anterior synechia" (should this occur at all as the result of iritis) will be found about its greater circumference.

(3) *Closure of the pupil* by inflammatory material, *opacities upon the lens-capsule* caused by adhesion of the "uvea" detached from the posterior surface of the iris.

(4) Dense inflammatory deposits in or beneath the capsule, or involving the superficial fibres of the lens itself (*capsular cataract*), may also be met with.

TREATMENT.—In treating iritis we must take care, *first*, to remove any local cause, such as a foreign body, opaque swollen lens, &c., and to cure granular lids, or remove inverted lashes. *Secondly*, we must endeavor to dilate the pupil *Thirdly*, to relieve pain. *Fourthly*, any constitutional treatment that may appear called for should be employed. (The means of carrying out the first indication are detailed elsewhere.)

In order to dilate the pupil a few drops of a strong solution (gr. iv to ℥j) of sulphate of atropine should be placed between the eyelids by the surgeon himself at each visit, and a weaker solution (gr. ¼ to gr. 1 to ℥j) should be used by the patient from four to eight or twelve times a day. If the case is treated at the commencement, more or less dilatation of the pupil will usually take place; but should the iris have become infiltrated with inflammatory matter, and adhesions formed, little or no effect will be produced; the atropine should, however, be persevered with.

In cases of iritis with suppuration the eye should be fomented frequently with hot belladonna lotion, and kept bound up with lint soaked in the lotion.

In cases accompanied by much pain blood should be taken from the temples by leeches or the artificial leech. Atropine may give rise to pain by causing dragging upon adhesions, and should be used with caution in cases where its application is attended by much suffering, especially if it have no effect upon the pupil. The eyes should be protected from light by a green shade or protectors until the inflammation has subsided.

Of *constitutional remedies* there is none so useful in the treatment of iritis *as mercury*. The drug should be given in some form or other, so as speedily to affect the system in all cases where inflammatory products are plentifully produced, whether the inflammation be of syphilitic origin or not. A pill containing gr. ij of Pil. Hydrarg. and gr. ¼ of Pulv. Opii may be taken three times a day, and is a very convenient and effectual mode of administration. Mercurial inunction, or vapor baths, may be employed if preferred.

If the iritis occur in debilitated states of the system, or the inflammation go on to suppuration, tonics, as iron or quinine, should be prescribed, and a plentiful supply of good food given. Should there be much pain opium must be given, and it is well to prescribe the drug in conjunction with extract of belladonna or hyoscyamus.

The results of iritis, should they seriously interfere with vision, require the performance of iridectomy or some one of the operations for artificial pupil. Iridectomy should also be performed in cases of recurrent iritis. The removal of a portion of iris in some manner—probably by preventing dragging on adhesions—has a marvellous effect in preventing recurrences.

Injuries.—The iris may be cut, torn, or bruised; prolapsed through, or adherent to, the cornea, in cases of penetrating wounds of that structure (*see* Wounds of the Cornea); or it may be separated from its insertion to a greater or less extent by concussion, without external wound. Any of these injuries are liable to set up iritis, which may possibly be followed by suppuration.

TREATMENT.—The injured eye should be kept carefully bandaged with lint soaked in belladonna lotion, and if much pain is complained of, or inflammatory symptoms arise, blood should be freely taken from the corresponding temple, either by leeches or the artificial leech.

As in iritis from other causes, the pupil may become blocked, or extensive synechiæ form, requiring operative interference at some later period. (*See* Operations on iris.)

HYPERÆMIA OF CHOROID.

Increased vascularity of the choroid is not unfrequently met with, more especially in myopic persons; it should be suspected if a feeling of fulness and tension of the eyes, accompanied by watering and intolerance of light, is complained of.

On examination with the ophthalmoscope increased redness of the choroid (especially of that portion nearest the outer side of the optic disk) and some enlargement of the choroidal vessels can be made out; these changes will, however, very probably be overlooked by an inexperienced observer.

TREATMENT.—The eyes should be kept carefully at rest, protected from light, cold douches employed, and all positions (as stooping or hanging the head) which cause congestion of the eyeballs carefully avoided; blood may be taken from the temples, and if glasses have been worn their use must be discontinued.

Inflammation of the choroid, "Choroiditis," occurs under much the same conditions as iritis; it also plays a prominent part in sympathetic ophthalmia, and is not unfrequently associated with inflammation of the iris — "choroido-iritis." Two forms will be commonly met with—simple and syphilitic.

Symptoms.—In all cases of choroiditis more or less loss of transparency will be found. Pain, intolerance of light, impairment of vision, fulness of the veins emerging from the sclerotic in the ciliary region, ciliary redness, dilatation and sluggishness of the pupil, and increased tension of the globe, are symptoms often met with in choroiditis, but are by no means characteristic of it. A diagnosis can only be made with certainty by examination with the ophthalmoscope.

The changes seen in the choroid with the ophthalmoscope are, grayish or yellowish patches or spots of exudation surrounded by more or less redness (hyperæmia), and at a later period patches of atrophy. The exudation may occur in one or more large patches, or be distributed over the whole or greater part of the choroid in the form of spots, the latter condition being known as "choroiditis disseminata." We know that the morbid changes noticed are in the choroid, from their relation to the retinal vessels which pass in front of and are not obscured by the opacity.

Syphilitic choroiditis (in typical cases) is characterized by yellowish lymph-nodules similar to those met with in syphilitic iritis in the choroid; but, as in the latter disease, typical cases are only occasionally met with, and we must be guided by the same rules in forming a diagnosis. Choroiditis disseminata is syphilitic; the atrophic changes left by it are seen in spots of white and dark dotted about the fundus; often combined with an irregular band of dirty white extending round the optic disk. These changes are frequently seen in the subjects of congenital syphilis, the choroidal disease is in many instances associated with floating opacities in the vitreous, and may be looked upon as a certain indication of syphilis.

Choroiditis is frequently associated with inflammation and opacity of the vitreous humor; the retina covering the affected portion of choroid is usually involved in the inflammatory change, and the optic disk may be implicated if choroiditis exist in its vicinity.

Atrophy of the choroid, as above stated, frequently follows inflammation. The ophthalmoscope shows white or dirty white patches, or spots corresponding to the areas previously occupied by inflammatory exudation, caused by destruction of the choroid, allowing the white sclerotic to show more or less plainly through it. The atrophic patches are frequently surrounded by dark borders, from accumulation of pigment which has been displaced by the inflammatory material.

Inflammation of the ciliary portion of the choroid (ciliary body) is known as "cyclitis."

Cyclitis is characterized by redness and swelling of some part or the whole of the ciliary region, with considerable enlargement of the veins of the retina, choroid, and iris, and pain in the eyeball, aggravated by pressure in the ciliary region. Cyclitis may be caused by injury or may depend upon syphilis, inherited or acquired. Softening and shrinking of the globe is very likely to follow from impairment of nutrition, dependent on interference with the circulation of blood. Suppuration may also take place. Wounds implicating the ciliary region of the sclerotic should always be looked upon as much more serious than those of other portions of the tunic, as cyclitis is frequently set up by such injuries. Cyclitis is not uncommonly associated with iritis—"irido-cyclitis."

TREATMENT.—The treatment of choroiditis should be very similar to that of iritis. Iridectomy does good in some chronic cases or in those in which there is increase of tension of the globe. For the atrophic changes no treatment is of much avail.

Bone upon the choroid.—Deposits of bone are not unfrequently met with upon the inner surface of the choroid in eyes that have been blind, and shrunken for years.

Tubercles in the choroid.—In cases of general tuberculosis deposits of tubercle have occasionally been met with in the choroid.

Injuries.—The choroid may be injured by foreign bodies entering the eyeball or ruptured by violence, without perforation of the tunics.

In the former case (more especially if a foreign body be lodged in the structure of the choroid) inflammation is very liable to follow, the eyeball being eventually lost by suppuration or shrinking. A rupture of the choroid from external violence is attended with more or less hemorrhage, which fills the rent made in its structure with blood, and may cause considerable displacement of the retina.

Seen with the ophthalmoscope soon after the receipt of the injury, a rupture of the choroid appears as a more or less elongated blood clot; later the blood becomes absorbed and a white linear figure is left, from the white sclerotic showing through the rent in the choroid. This form of injury is not often followed by destructive inflammation.

TREATMENT.—Injuries of the choroid should be treated in the same manner as injuries of the sclerotic, cornea, or iris, with belladonna lotion, lint and a bandage.

SYMPATHETIC OPHTHALMIA.

Sympathetic ophthalmia is the name applied to a peculiar form of inflammation of the choroid, ciliary body, and iris, coming on in one eye in consequence of morbid changes which have previously existed or are still in operation in the other.

The most common causes of sympathetic ophthalmia are injuries of one eye, *especially wounds implicating the ciliary region*, or associated with *lodgment* of a foreign body in the interior of the globe.

The wounded eye shortly after the receipt of an injury may become affected by choroido-iritis, the inflammation being of a *markedly adhesive character;* pain more or less severe will be complained of, sight rapidly lost, extensive synechiæ form, the tension of the globe, at first somewhat above par, diminish, and shrinking of the eyeball follow.

At any time during the foregoing changes in the injured eye the sound one may become irritable and painful, and a similar inflammation may be set up in it, leading rapidly to a like result.

TREATMENT.—Where sympathetic ophthalmia has been once established, in all probability irreparable damage will be done; the great point to bear in mind is to prevent its occurrence by *timely extirpation of the damaged globe* (*see* Extirpation of the Eyeball). Should the disease have become fairly established, little benefit can be expected to result from such extirpation, as the morbid changes will probably continue in the sympathetically inflamed globe, in spite of the removal of that primarily affected. The sympathetically affected eyeball (or if excision have not been performed both eyes) should be kept carefully bandaged with lint soaked in belladonna lotion; pain must be relieved by the same methods as in cases of iritis. Any constitutional treatment that may appear necessary should be employed, and as soon as the more acute inflammatory symptoms have subsided iridectomy should be performed. This operation often exerts a very beneficial influence upon the nutrition of the globe (*see* Iridectomy), and should be repeated a second or even third time should the new pupil become (as is very likely to be the case) occluded by inflammatory exudations.

Should suppurative inflammation be set up in one eye, sympathetic changes need not be feared in the other; it is only in the adhesive form of choroido-iritis that sympathetic ophthalmia is likely to occur.

THE VITREOUS HUMOR.

Opacities in the vitreous are frequently met with in cases of myopia, and often as the results of choroiditis.

Inflammation of the vitreous occurs occasionally; it is generally of syphilitic origin or caused by injuries, especially the lodgment of foreign bodies within the globe. Vision becomes misty, and on examination the humor is found to be more or less turbid.

TREATMENT.—Should the inflammation be of syphilitic origin; antisyphilitic remedies should be employed; should it depend on injury, the eye must be kept bandaged with lint soaked in belladonna lotion, and measures taken to subdue the inflammation.

Hemorrhage into the vitreous.—Occasionally bleeding takes place into the vitreous humor to a considerable extent. Impairment of vision is complained of, usually coming on suddenly, and often during some exertion. Examination with the ophthalmoscope (direct method) shows the vitreous chamber to be occupied by a turbid irregular cloud which floats about as the eyeball is moved, gradually subsides to its lower part when the movements are discontinued, and is stirred up again on the movements of the globe being repeated. The blood becomes absorbed to a greater or less extent in the course of time, but very commonly some permanent opacity is left.

Iridectomy appears to hasten the process of absorption.

GLAUCOMA.

By **glaucoma** we understand "A series of morbid changes of the eyeball; the most prominent of which, and apparently the one which causes all the others, being an increase of tension of the globe." (Bader.)

The cause of the increase of tension is unknown, but is supposed to result from undue accumulation of the intra-ocular fluids, dependent on hyper-secretion or deficient removal. Glaucoma is said to be *simple* when the increase of tension progresses slowly and continu ously without inflammatory outbreaks; *acute or chronic* when attended by attacks of inflammation.

Simple glaucoma presents no very marked symptoms, its onset being most insidious. It is characterized by gradual decrease of acuteness of vision, with narrowing of the visual field, impairment of the power of accommodation, causing rather rapid increase of presbyopia, sluggishness in the movements of the iris, some dilatation of the pupil, and some apparent haziness of the lens. Increase of tension is probably one of the earliest symptoms, but is very liable to be overlooked until the disease is far advanced and considerable hardness of the globe has taken place. With the ophthalmoscope spontaneous pulsation of the retinal arteries may be seen, or pulsation may be produced by very slight pressure upon the globe. The vessels, especially the veins, are thinner on the surface of the optic disk than in the surrounding retina, and the disk itself more or less cupped. The cup of glaucoma is characterized by a bluish appearance of the greater portion of the disk; upon this blue portion the vessels appear very small and indistinct, or they may be quite invisible; the margin of the disk is white, and the large tortuous retinal vessels are seen curling up over its edge, and appearing on the surface of the retina at a point not continuous with their course upon the nerve surface. Small hemorrhages may also be met with upon the retina.

Sooner or later, in any form of glaucoma, if relief be not given, the condition known as *absolute glaucoma* is established. The eyeball becomes stony hard, the pupil widely dilated and fixed, the cornea hazy and anæsthetic, the iris and aqueous humor discolored, the anterior chamber shallow, and the lens more or less opaque. A few dilated veins are seen issuing from the globe in the ciliary region, the sclerotic may be somewhat bulged in places and bluish in color, and the conjunctiva is extremely rotten, tearing on any attempt to seize it with forceps. On examination with the ophthalmoscope all apapears dark behind the pupil, or a dull red reflection may be returned from the interior, but no details of the fundus can be made out. All perception of light is lost.

In some cases of acute glaucoma, and almost invariably in chronic glaucoma, the onset of the disease is preceded by premonitory symptoms.

These are, as in simple glaucoma, rapidly increasing presbyopia and slight increase of tension of the globe, sluggishness and dilatation of the pupil, some apparent haziness of the lens, and narrowing of the visual field.

Besides these we may find some congestion of the veins emerging from the sclerotic in the ciliary region. There may be periodic attacks of dimness of vision, objects appearing as if veiled by a grayish or yellow mist (London fog); in the later stages we may have a halo around a flame, or the appearance of a rainbow, and at times attacks of pain in and about the eyeball.

Acute glaucoma usually commences suddenly with well-marked inflammatory symptoms. The patient will state that he was seized (frequently during the night) with sudden severe pain in the eye; the pain will be described as affecting, not only the eyeball, but the whole of the corresponding side of the head, and he will have found that the sight of the painful eye is much impaired or entirely lost. On examination the eyelids will be found slightly reddened and swollen, the conjunctiva somewhat chemosed, and its vessels, as well as those situated more deeply in the subconjunctival tissue, enlarged. There will be profuse lachrymation, and often much intolerance of light; the aqueous humor will very probably be somewhat turbid. The pupil will be dilated, somewhat irregular and fixed, and the tension of the globe greatly increased.

On examination with the ophthalmoscope some of the appearances mentioned under simple glaucoma may be found, but the media will probably be so hazy as to obscure the parts behind, a dull-red reflection being all that can be made out.

The acute symptoms may pass off in the course of a few days or weeks, leaving the eye more or less permanently damaged. Similar attacks may recur, but more frequently the disease relapses into a chronic state.

Chronic glaucoma, the form most commonly met with, is characterized by the occurrence of slight inflammatory attacks, associated with temporary increase of dimness of vision and more or less pain in and around the eyeball. On examination the field of vision will be found to be limited, the tension of the globe increased, and if the patient present himself during an inflammatory attack the conjunctiva and subconjunctival tissue will be found unduly vascular, the pupil somewhat dilated, and the movements of the iris sluggish.

The loss of vision, in cases of chronic glaucoma, is attended by somewhat peculiar symptoms. Patients complain that their si [illegible] lways somewhat misty, that there is an appearance of a bright halo around a candle or other flame, that they see colors resembling a rainbow, and often of great beauty, and occasionally flashes of light and fiery circles; these latter symptoms are, however, common to all forms of retinal irritation. Vision is always worse during the inflammatory attacks and recovers to a certain extent during the remission, never, however, returning to the same condition as before the attack.

The ophthalmoscope shows changes similar to those mentioned under simple glaucoma.

There is yet another form of glaucoma requiring mention, fortunately rarely met with. Its principal characteristic is the extreme suddenness and violence of its onset; its symptoms resemble those of acute glaucoma in an aggravated form. This variety of glaucoma is known as *glaucoma fulminans*, and the eye attacked by it may be entirely lost in the course of a few hours. The attack is occasionally accompanied by severe headache and vomiting.

Glaucoma is essentially a disease of commencing old age, occurring most frequently between the ages of fifty and sixty, but occasionally in young adults, or even in children. Glaucoma almost always affects both eyes, not, however, simultaneously, but at more or less considerable intervals.

In order to diagnose glaucoma we must be well acquainted with the method of ascertaining the tension of the globe, and also with the use of the ophthalmoscope. (*See* Examination of eyeball, &c.)

We must also remember that the injurious effects of pressure are evidenced earliest in the peripheral portions of the retina, and should therefore very carefully examine the condition of the *visual field* in all suspected cases. (*See* Examination of field of vision.)

Cases are frequently met with in which great contraction of the visual field has taken place, although central vision is still acute. Another symptom which should lead us to suspect glaucoma is the *rapid increase of presbyopia*. Patients affected by the simple or chronic forms of the disease are constantly changing their glasses, as they find that those which at first appear to suit become useless in the course of a few months.

Apparent haziness of the crystalline lens is a symptom requiring special attention; otherwise the surgeon may fall into the fatal error of mistaking chronic or simple glaucoma for cataract, and allow the disease to continue until sight is irrevocably lost. In such cases ophthalmoscopic examination will most probably show that there is little or no real opacity of the lens, and this, aided by a careful examination of the tension of the globe and the state of the visual field, will prevent so disastrous a mistake.

Besides the foregoing we not unfrequently meet with what is known as "secondary glaucoma," *i. e.*, glaucoma coming on in the course of some other disease, as corneitis, ulceration of cornea, iritis, &c. Glaucoma occurring in young persons is usually secondary.

TREATMENT.—Glaucoma can be remedied *by operation alone*. And it is our duty to explain to the patient the nature of his case and urge upon him most strongly the *necessity* for operative interference.

Patients suffering from glaucoma often evince the greatest unwillingness to undergo an operation; this unwillingness is explained by the fact that during the *remissions* of the disease little or no inconvenience is experienced, and, moreover, even at the time that an attack of inflammation is present the sufferer will be encouraged by the hope that the symptoms will pass off (as they in all probability have done in previous attacks), leaving the eye but little damaged. Nevertheless we must always bear in mind *that an operation, to be successful, must be performed early*, and must not be satisfied until we have convinced our patient of this. Most patients will readily submit to an operation when one eye has been lost and the disease has commenced in the other.

Several operations have been practised for the relief of glaucoma, but iridectomy is that which gives the best results, and is almost universally practised at the present day. Iridectomy, to be effectual, should be performed as early as possible; as a rule, no good is likely to result from the operation in cases where vision has been reduced to bare perception of light; but in acute glaucoma much improvement may take place even though all perception of light have been lost for some days.

In performing iridectomy for glaucoma we must take care to remove the iris well down to its insertion and to excise a good broad piece (*see* p. 267); merely cutting away a portion of the iris near the margin of the pupil does no good. The operation is easy enough of performance in cases of acute glaucoma, but in those of old standing the structures become so rotten as to render it anything but simple.

In cases of glaucoma where for any reason an operation does not seem advisable we must do our best to give relief by medical treatment. The means which will be found most useful are the applications of sedative fomentations, administration of opium, and the local abstraction of blood by leeches or the artificial leech.

Atropine *should not be used* in glaucoma, as it causes increased vascularity of the globe, and with it augmentation of tension. Its application is recommended in most works on ophthalmic subjects, but it does more harm than good.

THE RETINA AND OPTIC NERVE.

Vision.—Space will not allow of a detailed account of all the anomalies of vision which may be met with. Before the introduction of the ophthalmoscope all cases of *want of sight* occurring without cause apparent to the unaided eye were collected together into two classes bearing the names of "amblyopia and amaurosis."

To the former were referred all cases where vision was much impaired but not entirely lost, to the latter cases in which not even perception of light remained. But now that the ophthalmoscope has come so generally into use, making the interior of the globe as accessible to our sight as the exterior, we have come to refer "amblyopia and amaurosis" to their proper causes, and the terms have fallen into comparative disuse. For instance, if in a case of want of sight we find on ophthalmoscopic examination that there is haziness of the vitreous, inflammation of the retina, &c., we do not say (as formerly) that the patient is "amblyopic," but that he is suffering from opacity of the vitreous, retinitis, &c. Again, in cases of total blindness, the ophthalmoscope will in all probability detect atrophy of the optic nerve or other lesion, and instead of saying that the patient is "amaurotic" we say that he is suffering from atrophy of the optic nerve, &c. The terms "amblyopia and amaurosis" may, however, still be used in some rare cases where there is a partial or complete loss of sight, associated with an apparently healthy condition of all the ocular structures.

Hyperæmia of the retina occurs from overstrain of the eyes in doing near work (especially in hypermetropic or astigmatic persons), or from constantly looking at bright light; the disease is not uncommon amongst engine-drivers and others who work over a blazing fire.

The patient complains of some dimness of vision, and a feeling of fulness and discomfort in the eyes. On examination with the ophthalmoscope the retinal vessels, both arteries and veins, will be found increased in size, and a greater number of each will be visible than in the healthy retina.

This form of hyperæmia may be described as "active;" another form of hyperæmia, affecting only the retinal veins, which become enlarged, tortuous, and sometimes varicose, may be described as "passive;" this condition is indicative of obstruction to the return of blood from the eyeball. (*See* Ischæmia.)

Hyperæmia of the retina, especially the active form, is not easily recognized, as the limits between health and disease fade almost imperceptibly into each other, and considerable experience is required in order to judge with certainty where one ends and the other begins.

Treatment.—Active hyperæmia should be treated by rest, carefully shielding the eyes from bright light by means of blue protectors or a shade. After the subsidence of the hyperæmia any anomaly of refraction should be carefully neutralized.

Passive hyperæmia is usually an indication of some more serious disease, and requires no special treatment.

Inflammation of the retina (retinitis).—*Causes.*—Retinitis most frequently depends on some constitutional condition, as albuminuria or syphilis; it may also arise from embolism of the vessels of the retina, hemorrhage into its substance, or from cerebral disease; from tumors or entozoa within the globe, exposure to sudden flashes of bright light, or wounds of the eyeball. It may also be secondary to choroiditis, iritis, or cyclitis.

Retinitis is characterized by hyperæmia of the retina, associated with more or less dense and extensive opacity of its structure, and frequently with extravasations of blood in its substance.

Disturbance of vision may be a prominent symptom, or the patient may hardly be aware that anything is amiss with his eyes. The degree of impairment of vision depends upon the situation and extent of the inflamed portion of the retina; for instance, a small patch of inflammatory exudation in the region of the yellow spot will cause much loss of sight, whereas a considerable amount of opacity situated peripherally will give rise to scarcely any symptoms.

Pain, photophobia, colored vision, and flashes of light, are symptoms occasionally met with in inflammation of the retina.

Acute retinitis is rarely met with, and if it should occur would hardly be recognized, as the inflammatory exudation would be transparent, and, therefore, invisible; consequently the only appearance revealed by the ophthalmoscope would be enlargement and tortuosity of the retinal vessels.

The forms of retinitis which give rise to striking ophthalmoscopic appearances are essentially of a chronic nature, and are frequently associated with inflammatory changes in the choroid and optic nerve.

Retinitis may affect one or both eyes, those forms which are of constitutional origin usually affecting both, though not always in the same degree. Several varieties of retinitis are described.

Simple retinitis.—The ophthalmoscope shows a more or less general turbidity of the retina, varying from a scarcely perceptible cloudiness (giving the idea that the structure is colored and visible instead of entirely transparent) to an uniform grayish-white or mottled opacity, which appears to cover the choroid like a veil.

The outline of the optic disk is indistinct. The retinal veins appear enlarged, dark colored, evidently gorged with blood, often twisted in their course, and they may be in parts hidden by the inflammatory exudation. The condition of the arteries is nearly normal, or they may appear too thin.

Small hemorrhages are frequently detected in the course of the distended veins.

Hemorrhagic retinitis.—The optic nerve will be found reddened, somewhat swollen, its outline obliterated, its transparency so much affected that the course of the retinal veins upon its surface and in its substance cannot be traced; the retinal veins are turgid, and tortuous in their course, presenting alternately light and dark portions, according as they lie deeply in the engorged retina or more superficially near its inner surface. The retinal arteries, as in the simple form of retinitis, are nearly normal or too thin.

The principal characteristic of the disease is the occurrence of extensive hemorrhage, most marked around the optic disk, and fading away gradually into the surrounding parts. The blood-extravasations have a peculiar striated appearance, and radiate, spoke-like, from the optic disk as a centre. In some cases the retina immediately surrounding the disk is uniformly soaked with blood, the bright red color thus produced gradually shading off externally into the spoke-like appearance above mentioned.

As time goes on the extravasated blood undergoes changes, becoming brown in color, and eventually partially or entirely absorbed.

Retinitis pigmentosa is a peculiar form of degeneration of the retina, met with most frequently in the offspring of blood relations; the sufferers are often deaf and dumb, and may be partially idiotic.

The most marked symptoms of the disease are *night blindness*, and *gradual narrowing of the visual field without glaucomatous symptoms.* The ophthalmoscope reveals the most striking changes; the retina, more especially about its peripheral parts, is dotted more or less thickly with black pigment spots; these spots appear somewhat like a multitude of small black spiders with many legs; they have also been likened to bone-corpuscles. The spots of pigment appear to follow the course of the bloodvessels of the retina, and, as before stated, are collected most thickly in its peripheral parts.

The bloodvessels themselves are much diminished in size and visible number, and the optic disk is markedly anæmic.

Albuminuric retinitis is a peculiar form of retinitis met with in Bright's disease. The changes which take place in the retina are inflammation with effusion and hemorrhages, followed by fatty and fibrinous degeneration of its structure, and subsequent atrophy.

The ophthalmoscope shows, in the early stages of the disease, retinal hyperæmia (more especially venous) with increased vascularity and redness of the optic disk. Next the retina becomes cloudy (more especially around the optic disk, the outline of which becomes obscured), and numerous hemorrhages in the form of streaks and spots occur in various parts of its structure.

The cloudiness goes on increasing and obscures the smaller vessels; later in different parts of the fundus, but mostly in a ring situated at a little distance from the margin of the disk, appear glistening white spots and patches, which by their coalescence eventually form a broad white band, which partially or entirely surrounds the now gray opaque optic disk, being separated from it by a gray opaque portion of retina. These appearances are entirely characteristic of albuminuric retinitis.

Whilst the above changes are going on in other parts of the retina, characteristic appearances may be developed in the region of the yellow spot. A number of small white glistening spots, which, however, do not coalesce so as to form a band, but remain distinct, make their appearance. These glistening spots are arranged in a somewhat radiated position around the macula as a centre, and somewhat resemble a constellation; the appearance is quite characteristic, and once seen is not likely to be forgotten.

As the opacity of the retina increases, the vessels become more and more obscured, so that when the disease has reached its height only a few large venous trunks are still visible. Fresh hemorrhages may occur at any time, and cover over and obscure the opaque portions of retina. After a time a retrograde process sets in, the hemorrhages and peculiar opacity slowly disappear, the retina being at length left in a state of atrophy. Displacement of the retina may occur.

Albuminuric retinitis is usually associated with granular kidney; it is dependent on the blood-vascular disease (arterio-capillary-fibrosis, Gull and Sutton), of which the kidney affection is only a part. The retinitis often appears before any sign of kidney mischief is manifested, and it is the ophthalmic surgeon who first discovers the nature of the case.

Leucæmic retinitis.—A peculiar form of retinitis somewhat resembling the albuminuric has been described as occurring in connection with leucocythæmia.

Leucæmic retinitis is marked by pallor of the optic disk, a peculiar rose color of the retinal vessels, hemorrhages, some opacity of the retina around the optic disk, and white glistening spots similar to those met with in albuminuric retinitis, which, however, are situated in the peripheral parts of the retina.

Embolism of the retina.—A form of retinitis associated with plugging of the central artery comes on suddenly without apparent cause, with complete loss of sight. Ophthalmoscopic examination shows some pallor of the optic disk and diminution in calibre of the vessels emerging from it, but the most marked change is seen in the region of the yellow spot.

The retina around the spot is gray and opaque, and numerous bloodvessels not visible under ordinary conditions come plainly into view; the macula itself is seen as a bright red spot (which might be taken for a hemorrhage by a careless observer) situated in the centre of the opaque portion of retina.

The bright red appearance of the macula arises from the anatomical arrangement of the parts; the retina in this situation, being thin and firmly bound down to the parts beneath, does not become infiltrated with inflammatory exudation, and consequently the normal red color of the fundus appears in striking contrast to the surrounding opaque retina. Hemorrhages may occur.

Syphilitic retinitis. — A form of inflammation affecting the retina immediately surrounding the optic disk has been looked upon by some as of syphilitic origin, but, like syphilitic iritis, rarely presents any very characteristic signs. Should retinitis occur with other manifestations of syphilis, congenital or acquired, it may be looked upon as syphilitic.

TREATMENT.—Both eyes should be kept thoroughly at rest, by prohibiting all near work, paralyzing the accommodation by atropine, and shielding the eyes from the stimulus of too bright light by blue protectors. Everything that is likely to cause disturbance of the ocular circulation, as stooping positions, excitement, stimulants, too rapid variations of temperature, &c., should be carefully avoided.

In simple retinitis blood should be taken from the temples by leeches, or preferably by the artificial leech, and in this form as well as in retinitis connected with syphilis mercury does good; it should be given so as quickly to affect the system either by the mouth, by inunction, or in the form of vapor baths. In cases of long standing, however, small doses of the bichloride of mercury, taken regularly for some months, may be beneficial. The other forms of retinitis are of only secondary importance to the disease with which they are associated, and against which treatment must be directed (*see* Causes of Retinitis). No treatment is of much avail in retinitis pigmentosa.

Atrophy of the retina may be the sequel of inflammatory changes. Its principal characteristic seen with the ophthalmoscope is a condition of bloodlessness, in some cases associated with opacity of the retina and frequently with atrophic changes in the choroid. Bloodlessness shows itself in a diminution of the visible number and also of the calibre of the retinal bloodvessels, more especially of the arteries, some of which may appear pervious to red blood-corpuscles in part of their course, only their continuations being marked by a yellowish-white cord. Opacities, if they occur, are of a grayish-white color, and situated for the most part around the optic disk.

The disk itself is frequently extremely anæmic or atrophied. (For treatment of atrophy of the retina, *see* Atrophy of the optic disk.)

Hemorrhage into the retina.—Besides the form of hemorrhage described as occurring in retinitis, bleeding may take place into the structure of the retina, from rupture of a retinal bloodvessel without previous inflammatory change. The hemorrhage is usually considerable, and will be seen as an irregular patch of blood, situated somewhere in the course of the ruptured vessel, and often surrounded by inflammatory exudation.

The extravasated blood becomes gradually absorbed, but usually leaves behind it some indications of its previous existence.

TREATMENT.—Rest of the eyes and protection from bright light.

Displacement of the retina is associated with effusion of serous fluid between it and the choroid; it may be caused by blows on the eyeball or the head in its vicinity; it may occur without apparent cause, and is often met with in myopic eyes. Displacement of the retina occurs by preference at its lower part, but may vary in extent from detachment of a small fold to total separation of the whole retina from the choroid, the only points of attachment left being at the optic disk and ciliary processes.

The ophthalmoscope shows a gray, opaque, movable cloud, over the surface of which the retinal bloodvessels can be traced.

TREATMENT.—Little can be done to remedy displacement of the retina, but an attempt should be made to procure absorption of the fluid by the administration of such drugs as iodide of potassium and mercury, and by the application of blisters to the temple. If the displacement occur in connection with myopia the anomaly of refraction should be carefully neutralized by suitable glasses, and in all cases rest should be insured to the eyes, so as to prevent as much as possible further detachment.

Inflammation of the optic disk (optic neuritis, neuro-retinitis) occurs as the result of irritation of the trunk of the nerve in some part of its course external to the eyeball, the inflammatory change extending downwards along the nerve and finally affecting its intra-ocular portion, hence it is sometimes described as "descending neuritis." The ophthalmoscope shows a reddish-gray turbidity of the disk and the surrounding zone of retina, accompanied by swelling of the parts. The retinal veins are engorged, but their visible number is not increased; the arteries are thinner than usual, and all the vessels are more or less shrouded and concealed from view in the opaque portion of retina and upon the nerve surface. Numerous small hemorrhages may occur upon the disk and around it.

Vision is always considerably affected in *optic neuritis.*

Ischæmia of the disk (choked disk).—Choking of the optic disk is met with in a large majority of cases of cerebral tumor or other affections within the cranium which cause obstruction to the return of venous blood from the eyeball. It is frequently confounded with optic neuritis, from which, however, it differs in some essential particulars. In choked disk the intra-ocular portion of the nerve alone is affected. The ophthalmoscope shows great swelling and an intense red color of the disk, its outline being entirely lost; there is, however, but slight swelling or opacity of the surrounding retina; small hemorrhages are frequently seen on the nerve surface. The retinal veins are enormously distended, their course extremely tortuous, and they may be varicose; their visible number is also considerably increased. The arteries are thinner than natural or of normal calibre; none of the vessels are shrouded and concealed from view, as in neuritis. In by far the greater number of cases of ischæmia of the disk vision is unaffected. Ischæmia may go on to neuritis.

Generally speaking, optic neuritis commencing as such may be looked upon as indicative of irritation of the nerves in some part of their course.

Ischæmia means simply obstruction to the venous circulation, and may result from pressure directly on the main trunks, or from any form of disease whatever which causes *over-crowding* of the contents of the cranium. Both neuritis and ischæmia are usually bilateral.

TREATMENT.—Optic neuritis and ischæmia of the disk are of only secondary importance to the disease which gives rise to them; they are of much greater interest to the physician than to the oculist, as their existence enables him to diagnose cerebral lesion with great certainty.

Atrophy of the optic nerve is usually the result of preceding neuritis, when it is called "consecutive atrophy," but occasionally cases are met with where the atrophy seems to have commenced as such, and to have slowly progressed without inflammatory change, "simple atrophy."

With the ophthalmoscope the optic disk will be seen to be white or bluish white in color, frequently its margin appears irregular, and it may be cupped. The atrophic cup varies from the glaucomatous in not having steep sides, so that the vessels do not appear broken in their course as in the latter affection; it does not take in the whole nerve, but only its central part, which slopes gradually backwards; the vessels appear curved on the surface of the disk, but are not altered in calibre as in glaucoma. Atrophy of the retina frequently goes along with atrophy of the optic disk.

In cases of atrophy of the optic nerves vision is always much impaired; some patients with extremely white disks can count fingers or even distinguish large letters, but in the majority of cases vision is reduced to bare perception of light.

Treatment.—The treatment of atrophy of the optic nerves, especially if associated with a similar condition of the retina, is most unsatisfactory, and, indeed, almost hopeless. Should a certain amount of vision still remain, and no change have taken place for many months, we may safely assure our patient that he will retain what sight he has. The drugs which have been principally used are iron, either alone or in combination with nux vomica, strychnia taken by the mouth or injected hypodermically, phosphorus, quinine, or other tonics, and opium in gradually increasing doses. Galvanism has also been employed.

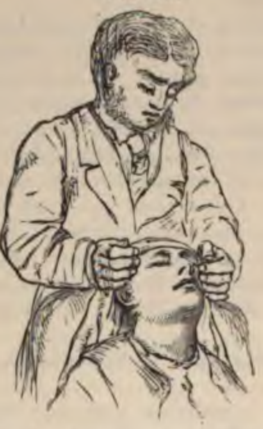
OPERATIONS ON THE EYEBALL AND ITS APPENDAGES.

POSITION OF THE PATIENT AND OPERATOR, &c.

All the minor operations, such as slitting the canaliculi, passing probes down the nasal duct, opening tarsal cysts, &c., can best be performed when the patient is seated in a chair, and the operator stands behind him; the patient's head, over which a towel has first been thrown, resting against the operator's chest. (*See* Fig. 93.)

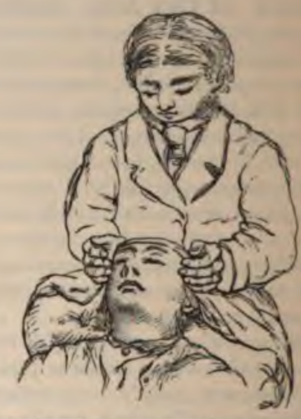
The more important operations, as extraction of cataract, iridectomy, squint, &c., should be performed whilst the patient is lying on a hard couch, his head resting on a bolster covered by a towel, which should be thrown forward over the forehead; the operator should sit or stand behind (*see* Fig. 94). In whichever position an operation is to be performed, the chair or table should be placed in front of a large window so as to insure a good light, and care be taken to prevent assistants and others from interposing their heads or bodies between the patient's face and the source of light. It will be found whilst operating that, with the exception of occasional pronation and supination, there is little occasion to use the arms, which should be kept with the elbows near the sides, the wrists resting on the patient's head or face, in a position which allows of free movements of the hands and fingers.

Fig. 93.



Position for minor operations. (Sitting.)

Fig. 94.



Position for major operations. (Lying.)

Every ophthalmic surgeon should learn to use his fingers, cultivate his sense of touch, and, if possible, become ambidextrous.

It will be found that incisions can be best made by holding the knife lightly between the umb and first two fingers of whichever hand is most conveniently situated.

In all operations incisions commencing at or situated entirely on the outer aspect of the obe should be made with the hand corresponding to that side, the opposite hand being nployed upon the inner side. That is to say, if the right eye is operated on, the right and should be used to make an incision at its outer side, the left at its inner, and *vice ersâ.*

Incisions above or below may be made with either hand; scissors should also be used ith whichever hand is most favorably situated.

In one operation, that for internal strabismus, the positions of patient and operator are omewhat different from those already described, the operator standing in front, at the side f the couch on the patient's right, instead of behind his head.

The scissors may be used with the right hand for both eyes, but in operating on the left the hands will have to be crossed.

Before performing any operation the operator should look carefully to the condition of the instruments he is about to use. Knives should be passed through a piece of thin leather tightly stretched on a small metal cylinder, and care taken to ascertain that they have good points and that there are no notches in the blades.

Scissors should be carefully examined and tried; it should be seen that forceps close perfectly and free from rust or dirt; silk for sutures should be black, as fine and strong as possible, well waxed, and free from flaws or kinks. Inattention to these details may very possibly mar the success of an operation.

Administration of anæsthetics.—The operator will find that he has much more command over the eye when the patient is under the influence of an anæsthetic than when consciousness remains, and in by far the greater number of cases he will do well to administer one.

Occasionally patients are met with who will bear operations most quietly; such should be operated on without anæsthesia; but if during the operation the patient become unsteady, or begin to strain, it is best not to risk failure, but to discontinue the operation and administer an anæsthetic. If the globe has been opened, it must be carefully guarded by a pad and bandage during the administration. If no anæsthetic be employed the operation should be performed as simply and quickly as possible; no speculum should be used, nor should the eye be fixed with forceps, but the operator should keep the lids open, and steady the globe with the fingers.

AFTER-TREATMENT.—Operations on the tear passages, removal of tarsal cysts and strabismus, require little or no after-treatment; the parts need only to be washed twice or three times a day with tepid water.

After more severe operations on the eyelids, and in all cases where an incision has been made into the globe, the eye should be carefully covered with two small folds of lint, wetted with cold water, and secured by a single turn of bandage; the lint being kept wet and the eye bound up until the incision has healed and all irritation subsided. Wounds of the globe made in operations, as a rule, heal rapidly, union having frequently taken place at the end of twelve hours.

The great danger after operations on the globe is the occurrence of inflammation.

Inflammation, once set up, may subside shortly, leaving no trace behind it; it may continue until more or less irreparable damage has been done, or may run on to suppuration of portions or the whole of the globe; the cornea is more liable to this change than any other structure.

The symptoms of inflammation usually appear within the two days immediately succeeding an operation, and little fear need be entertained for the safety of the eyeball if all as gone well for a week.

Occasionally, after cataract extraction, eyes have been lost through inflammation, or ppuration commencing at a later period, but these cases are rare, and probably it will e found that some damage has been done to the eye shortly before the symptoms ppeared.

The treatment of inflammatory changes consists in the local abstraction of blood from e temple by leeches, or the application of the artificial leech; the use of fomentations water, poppy-heads, or belladonna constantly applied; the administration of opium in l doses, either alone or combined with mercury. The treatment must, of course, be ried according to the condition of the patient; should he be weakly and anæmic, we ould be careful about bloodletting, and instead quinine and iron, with good living and air amount of stimulants, should be prescribed.

The local abstraction of blood, however, acts most beneficially in relieving pain, and should therefore be employed in cases where pain is a prominent symptom, even though the patient does not appear to have much blood to lose. Strong healthy patients should be leeched freely, and kept on light diet.

During the treatment the eye must be kept carefully closed and bandaged, except during the time that fomentations are being applied. Moderate pressure by carefully applied pads of lint and cotton wool, secured by a few turns of flannel bandage, is said to exert considerable influence in cases where the cornea is threatened by suppuration; it should have a fair trial, if pressure can be borne.

If the inflammation go on to suppuration of the whole globe the case must be treated in the same manner as abscess in any other part. (*See* Ophthalmitis.)

Insertion of a seton in the temple.—In order to place a seton in the temple, the position of patient and operator should be as in Fig. 93, p. 250. The operator should pinch up the skin with the finger and thumb of one hand, just in front of the patient's ear, and pass a seton needle armed with a double thread of stout silk through the fold thus produced; the silk should be drawn through and tied in a short loop. The seton should pass for about 1½ in. beneath the skin, and should be placed amongst the hair, so as to avoid as much as possible disfigurement from the subsequent cicatrix; the silk should be drawn backwards and forwards through the wound every morning; it may be left in as long as appears necessary.

Care must be taken in passing the needle not to wound the temporal artery; should this accident happen the seton must be removed and firm pressure applied with a pad and bandage.

Application of the artificial leech.—This instrument consists of a small sharp steel cylinder (worked by a spring arrangement), with which a circular incision can be made through the skin of the temple, and a hollow glass cylinder, which can be placed over the wound, and the air in its interior exhausted by means of a piston worked by a screw; as the air is removed the blood flows up to fill the vacuum. Care must be taken not to work the screw too quickly, but only to move the piston at the same rate as the blood flows; neither must the edge of the cylinder be allowed to compress the skin against the parts beneath, otherwise the flow of blood will be impeded.

THE EYELIDS.

Tumors.—Various small growths are met with about the eyelids. **Molluscum** occurs as a small yellowish-white projection, having a depressed and often blackened centre, situated on some part of the skin of the lids; there may be only one or many of these little growths. They can be easily removed by thrusting a knife through them, and then squeezing out the contents with the thumb nails.

Dermoid cysts are not unfrequently met with situated deeply beneath the skin and muscle, often near the outer angle of the orbit. They are congenital, filled with sebaceous matter, and often contain hair. They must be carefully dissected out, much more trouble being experienced in so doing than would be at first suspected, and they will in all probability be opened during removal. These little tumors will be found attached deeply to the periosteum, and may have caused a depression in the bone.

Warts are not unfrequently met with about the eyelids; they should be cut off with scissors.

Tarsal cyst is met with as a dusky red or colorless projection from the outer surface of the lid; its position is marked on the conjunctival surface by a bluish spot, from which a granulation is occasionally seen growing. The cyst is formed by obstruction of a Meibomian gland and retention of its secretion; it is sometimes in a suppurating condition.

The lid should be everted, the cyst freely opened from the conjunctival surface with a small knife, and its contents squeezed or scooped out; it must be thoroughly emptied, or it will, in all probability, re-form.

The cavity left on removal of the contents of the cyst will always fill with blood, and shortly after the operation the tumor will be as large or larger than before; the patient must be warned of this.

The swelling will most probably disappear in the course of from four to six weeks; if it remain longer the operation should be repeated.

A tarsal cyst sometimes degenerates into a hard fibrous little mass, feeling somewhat like a large shot beneath the skin, which is known as a *chalazion;* this should be dissected out through an incision in the skin of the lid, which should afterwards be closed by a fine suture.

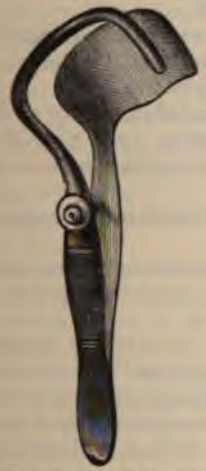
Xanthelasma is often met with as a small yellow patch on some part of the skin of the eyelids; its most frequent site is the surface of the upper lid near the inner canthus The little patch may be excised if it is a source of anxiety to the patient.

Simple serous cysts occur about the margins of the lids; they are about the size of small peas, and nearly transparent. A portion of the cyst wall should be cut out with scissors.

Trichiasis signifies a faulty direction of the eyelashes, which turn inwards and irritate the cornea; it is usually caused by contraction of the conjunctiva (following granular ophthalmia or its unskilful treatment), producing displacement of the hair *follicles.*

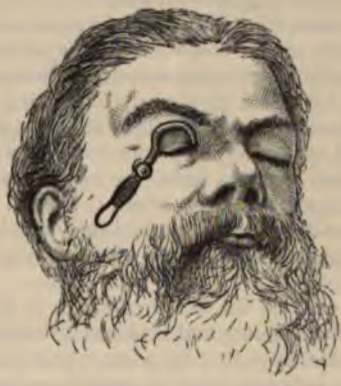
Only a few lashes may be misdirected, or the whole row may be inverted. If only a few of the lashes turn inwards, it is sufficient to pull them out with forceps whenever they become troublesome. If a considerable number or the whole row are inverted, their roots should be removed by operation. The operation should be performed as follows: The patient being placed in the usual position (*see* Fig. 94, p. 250), the lid should be secured by a compressorium forceps (Figs. 95, 96), by which means it is steadied and hemorrhage prevented, care must be taken not to screw the instrument up too tightly, or sloughing of the lid may follow. The lid being well secured, the operator should make an incision through the skin, about three lines from the free margin of the lid and parallel with it, of such a length as to correspond to the lashes which are misplaced; the incision should be carried down to the outer surface of the tarsal cartilage; a second incision should then be made of the same length as the first, in the margin of the lid, and so conducted as to split the lid and separate the skin and hair-bulbs from the subjacent structures; the ends of the two incisions should then be joined by two short cuts, and the portion of skin included with the hair-bulbs dissected off the tarsal cartilage. The raw surface should then be wiped with a sponge, and any black dots denoting the presence of hair-bulbs carefully removed. The compressorium forceps should then be unscrewed, when sharpish hemorrhage will take place. The eye must be covered by two pieces of wet lint secured by a turn of bandage.

FIG. 95.



Compressorium forceps.

FIG. 96.



Compressorium forceps applied.

Entropion signifies a rolling inwards of the whole lid, the whole row of lashes being completely turned towards the eyeball; it is most frequently met with in the lower lid, more especially in old people with a superabundance of loose skin about the face. It is often the cause of much trouble and annoyance, as well as of danger to the eye, after cataract extraction.

The inversion may be caused either by spasmodic contraction of the orbicularis muscle or by distortion and thickening of the tarsal cartilage after granular ophthalmia.

Entropion caused by contraction of the orbicularis is easily remedied as follows:—The patient, lying on a couch (*see* Fig. 94, p. 250), the operator should seize with forceps the skin of the lid at a point near one or other canthus, about two lines from its margin, and then with scissors remove a portion in breadth corresponding to about half the surface of the lid, and extending along its whole length; he should then seize and remove the orbicularis muscle to a corresponding extent; no suture need be used; the eye should be bound up with wet lint and a bandage. The subsequent healing of the wound and contraction of the cicatrix will remedy the inversion.

Entropion depending on distortion and thickening of the tarsal cartilage is usually met with in the upper lid. It can be remedied by removal of a wedge-shaped piece of cartilage, including the more thickened portion, by the following operation:—The patient, being in the usual position (see Fig. 94, p. 250), and the lid fixed by a compressorium forceps, an incision should be carried through its whole thickness, parallel with and about two lines distant from its margin, along the whole extent of the thickened portion, with a sharp knife. A somewhat lunated incision should then be made from one end of the first around the base of the thickened portion of tarsus joining the first incision at its other extremity; the second incision should not be carried vertically through the cartilage, but obliquely, so as to meet the first at the conjunctival surface; the portion of cartilage included between these incisions should then be removed, the wound closed by sutures, and the eye bound up with lint and a bandage. The skin and muscle covering the cartilage may be removed or not, according to the fancy of the surgeon. If their removal is not desired, they should be dissected back before making the second incision. After the operation the margin of the lid should appear rightly directed.

Ectropion signifies an everted condition of the lid; the extent of eversion varies in different cases, from slight falling away of the margin of the lid from the globe to eversion of the whole extent of the lid and adjoining fornix of the conjunctiva.

The slighter forms are caused by distension of the lid from inflammatory swelling, and are easily remedied by slightly narrowing the palpebral aperture, by paring the edges of the lids near the outer canthus, and bringing the raw surfaces together by a suture, when firm union will take place between the two.

The more extreme forms are caused by the contraction of cicatrices of burns, wounds, or inflammatory changes, about the orbit.

No definite rules can be laid down with regard to the treatment of these cases. The surgeon must be guided by the conditions as they present themselves, and do the best he can.

In any case, if the tarsal cartilage be left entire, it should be carefully dissected away from its attachments and replaced as nearly as possible in its normal position, in which it must be kept by paring its margin and that of the opposite lid, and securing extensive and firm union between them by careful coaptation of their raw surfaces. The lids must not be opened until all further contraction of the original cicatrix is at an end, and it is better to leave the eye closed for considerably too long a period than to open it a day too soon. Ectropion is also frequently seen in the more severe forms of ophthalmia or in cases of severe intolerance of light, and is especially liable to occur when an attempt is made to open a firmly closed eye. In these cases the eversion requires no special treatment, but disappears as the affection causing it is recovered from.

Formation of a new eyelid.—In some cases of burn, or from ulceration of a lupoid character, more or less complete destruction of the eyelids may take place. To remedy this defect, a flap of skin from a neighboring part may be brought, placed in the gap, and there secured by means of sutures, care being always taken that the piece of skin is considerably larger than the surface it is intended to cover. Before removing any skin, search must be made in any portion of the eyelid that may be left for the tarsal cartilage, and if this be found it must be carefully dissected out and preserved, its natural form being as much as possible restored; it should be fixed in its proper position by uniting its margin to that of the opposite lid. Even if no flap of skin be applied over it, it will in time become covered with cuticle, and form a very effectual covering to the eyeball.

Symblepharon signifies adhesion of the conjunctiva of the eyelid to that of the globe. It is usually caused by burns with lime or hot metal, and may occur to any extent, varying from a thin band of union to fusion of the greater part or whole of both lids with the globe.

This condition requires to be remedied by operation. Where only a thin band of adhesion exists it should be first carefully secured by a suture passed through the extremity nearest the eyeball, and then be divided, and drawn into the fornix by passing the suture through the lid and securing it to a small roll of strapping, placed upon the cutaneous surface. By this means the raw surface left by removal of the band from the globe is brought into contact with healthy conjunctiva and granulates over, healing without forming adhesions.

If more than one band exist, each should be dealt with separately.

Cases of more extensive adhesion give rise to the utmost difficulty in treatment, and until lately the operations performed for their relief were attended with only indifferent success. One plan of treatment recommended was to dissect away the adhesion and interpose a shell of glass between the raw surfaces, but as healing invariably commenced at a point remote from the free margin of the lid, the shell was gradually pushed out and the adhesion re-established.

The insertion of pieces of wire deeply beneath the adhesion, which were left in until the walls of the canal made by them had healed, the remainder of the adhesion being then divided with scissors, was followed by no more satisfactory results.

Lately, an operation has been introduced by Mr. P. Teale, of Leeds, which has been attended with the best success. The operation has for its object the separation of the raw surfaces by a piece of conjunctiva, taken from some other part of the eyeball. The following is an extract from the account of the operation given by Mr. Teale in the 'Transactions of the Fourth Ophthalmic Congress,' 1872. "The patient being under the influence of an anæsthetic, the eyelid is freed from its attachment to the lid; next, a band of somewhat circular form is marked out, with a sharp knife, upon the sound conjunctiva; the band commences at one end of the gap left by liberation of the lid and passes round the sound side of the cornea, terminating at the opposite extremity of the gap.

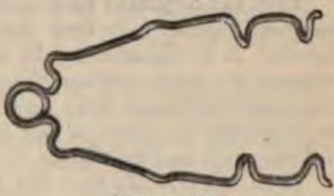
"Four stitches are then inserted, two on each edge of the flap thus formed. The flap is next separated on its *under surface*, whilst its extremities are left continuous with the conjunctiva; it is then drawn across the surface of the cornea, and fixed, raw surface downwards, into the gap formed by the liberation of the eyeball from the lid; it is secured in its new position by the sutures already alluded to, aided by as many others as may appear necessary."

Mr. Teale states that "the operation is most tedious," and that he rarely completes it within the hour.

Anchyloblepharon signifies an adhesion of the lids to each other. The adhesions must be divided with scissors, and, if possible, some skin or conjunctiva interposed between the raw surfaces; but if this cannot be done, reunion may be prevented by passing a probe between the lids daily.

Narrowing of the palpebral aperture (Blepharophymosis) is usually a result of granular ophthalmia, and is accompanied by entropion, displaced tear puncta, and consequent watering of the eye. It requires to be remedied by operation, which can thus be performed: the lids being kept widely open and on the stretch by a wire speculum (Fig. 97), an incision should be made with strong scissors through the outer canthus. A flap of conjunctiva, of somewhat conical shape, should then be marked out on the surface of the eyeball, the flap freely dissected from the subjacent structures, but left attached at its base, which is towards the cornea, and then fixed by sutures in the incision made by the scissors, in such a manner as to keep the raw edges separated by a mucous surface.

Fig. 97.



Wire speculum.

It is sometimes necessary to narrow or close entirely the palpebral aperture. This operation, known as *tarsoraphy*, can be performed as follows: The lid being held with forceps, a portion of *the inner edge* of its margin should be removed with a small iridectomy knife, care being taken not to cut away any of the outer edge containing the lashes, nor to wound the tear puncta or canaliculi. The opposite lid should then be treated in the same manner, and the raw edges brought together by sutures; firm union will soon take place between them.

Ptosis signifies a drooping of the upper eyelid to a greater or less extent, with inability to raise it. Ptosis occurs with divergent strabismus and more or less impairment of the mobility of the eyeball, in cases of paralysis of the third nerve, and is generally, but not invariably, accompanied by dilatation and fixity of the pupil.

It is also met with as a congenital defect, and occurs sometimes after severe inflammation of the lid, or protracted intolerance of light, and constant spasmodic action of the orbicularis muscle. Women past the middle period of life, with a superabundance of loose skin about the face, are also subject to a form of partial ptosis.

Treatment.—In ptosis from paralysis of the third nerve treatment must be directed against the cause of the paralysis, no operation being advisable; other forms can be remedied by removal of some skin and orbicularis muscle from the surface of the lid.

The operation may be performed as follows: The skin just above the margin of the lid should be pinched up with forceps, the amount included between their blades being such as to raise the margin of the lid well above the upper border of the pupil. Then with scissors a strip of skin of the required width should be removed, along the whole extent of the lid, parallel to its margin; the orbicularis muscle should then be clearly dissected off the tarsal cartilage to about the same extent, the wound closed by one or two fine sutures, and the eye bound up with wet lint and a bandage.

The wound will heal in the course of a few days, and the shortening caused by the removal of the skin and muscle, and subsequent cicatrization (possibly aided by the entanglement of some fibres of the occipito-frontalis in the scar) should keep the lid in the desired position.

In cases of congenital ptosis we often find movement of the eyes upwards greatly impaired; it seems probable that the superior rectus is badly developed or altogether absent.

THE LACHRYMAL APPARATUS.

The lachrymal gland is occasionally the seat of malignant or other growths, and may require extirpation.

A cyst is sometimes met with caused by obstruction of one of the ducts of the gland and accumulation of secretion. The disease is known as *dacryops*.

Its treatment consists in establishing an opening into it from the surface of the conjunctiva; this is easily done by passing a curved needle armed with silk from beneath the upper lid through the wall of the cyst into its cavity, and out again at a convenient distance; the silk should then be drawn through, and the portion of cyst-wall included between the entrance and exit of the needle firmly ligatured; the ligature will slough out and leave a permanent opening, causing no inconvenience. If the cyst be opened through the skin it may leave a troublesome fistula.

The tear puncta and canaliculi.—The tear puncta in the normal condition lie in contact with the ocular conjunctiva; they may be either everted, as seen in old and neglected cases of tinea, or rolled somewhat inwards; they are sometimes found entirely obliterated, either by disease or injury, burns of the eyelids being the most common cause.

The canaliculi may also be found more or less obstructed in any part of their course. Any of these conditions are accompanied by troublesome watering of the eye, "epiphora." They can be remedied by slitting the tear puncta and canaliculi.

The lachrymal sac is often the seat of acute inflammation, which may arise in the sac itself, spread to it from the conjunctiva, or be caused by disease of the surrounding bones. It is characterized by a dusky red, tense swelling, situated at the side of the nose, close to the inner canthus, the swelling and redness often extending outwards along both the upper and lower lids; one or both sacs may be affected. The inflammation may end in resolution or go on to the formation of an abscess; in the latter case, the swelling becomes soft and fluctuating.

Treatment.—At first, hot fomentations and poultices must be applied, and attention paid to the general health; if abscess form, the pus must be let out by a free incision. If an abscess of the lachrymal sac be allowed to burst, a fistulous opening will very probably be left, but if a free opening be made so soon as the formation of pus is suspected, the wound heals rapidly.

Distension of the lachrymal sac (Mucocele).—The lachrymal sac not unfrequently becomes distended, forming a tumor of varying size beneath the internal palpebral ligament (tendo oculi); pressure on the tumor causes the escape of a transparent, somewhat tenacious fluid, consisting of mucus and tears, in some cases thickened from the admixture of pus-cells. Distension of the sac is caused by stricture of the nasal duct and consequent accumulation of secretion; it is accompanied by more or less watering of the eye, and may be remedied by relieving the stricture of the duct.

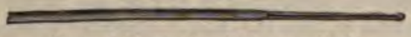
Discharge from the lachrymal sac (Blenorrhœa).—A muco-purulent or purulent discharge from the sac is often met with, following inflammation, especially if disease of the adjacent bone exist. It may be treated—1st. By insuring a free exit for the discharge by slitting the canaliculus, and passing a large probe down the lachrymal duct. 2d. By washing out the sac. 3d. By obliteration of the sac.

Stricture of the nasal duct may be met with in any part of its course; the obstruction, however, is most frequently found at its junction with the lachrymal sac. Occasionally the duct is found almost obliterated by dense bony deposit.

Fistula of the lachrymal sac occurs as a small, sometimes scarcely perceptible opening, situated at some point over the sac; it is found in connection with obstruction of the nasal duct. If the passage be re-established, the fistula will probably close.

Operations on the tear passages.—The operation of slitting the tear puncta and canaliculi may be performed thus: The patient should be seated in a chair, the operator standing behind him. (*See* Fig. 93, p. 250.) Supposing the lower punctum and canaliculus on the right side to be operated on, the small and ring fingers of the left hand should be placed upon the patient's face, near the outer canthus, the lids drawn tight, with these two fingers, and kept so; then a small grooved director (Fig. 98) should be taken in the right hand and passed at first vertically to the margin of the lid, through the tear punctum; its handle then depressed, and its point passed horizontally along the canaliculus into the sac. To ascertain that the point of the director is in the sac, the tension of the lids must be relaxed and the director pushed gently onwards; if there be any puckering at the inner canthus when the director is thus pushed, its point has not entered the sac, and a further attempt must be made; if no puckering occur, the lids should be brought again into a state of tension, and the handle of the director transferred to the thumb and forefinger of the left hand; a cataract or any small knife that will cut, should then be taken in the right hand, and run along the groove of the director well into the sac, the knife and director being then withdrawn together; the upper lid must be kept out of the way by one of the fingers of the right hand. The operation cannot be performed on the left side in the same manner, with the exception that the hands are reversed.

Fig. 98.



Grooved director for slitting canaliculus.

The upper punctum and canaliculus sometimes require to be slit; this operation is not quite so simple as that on the lower lid, but is performed in much the same way. In lieu of the grooved director and knife, a small probe-pointed canaliculus knife may be employed; it should be passed through the tear punctum and canaliculus in the same manner as the director, and will cut its way out as it goes.

The patient must be seen at intervals of two or three days for a week, or longer, after the operation, and a probe passed along the incision to prevent it closing.

Probing the nasal duct.—For the treatment of stricture of the nasal duct a set of silver probes (Bowman's) are used: there are three probes in a set, the two extremities of each being of different thicknesses, so that there are six sizes, No. 1 being the smallest, No. 6 the largest.

To pass a probe down the nasal duct, the canaliculus should be first slit, or, what is better, should have been slit at some previous time. The surgeon should stand behind the patient in the same position as for performing the last operation; and the lids being made tense in the same manner, the probe should be passed along the slit canaliculus until the point is well within the sac, as shown by the absence of puckering at the inner canthus on relaxation of the tension of the lids; the opposite extremity should then be raised along the margin of the orbit until the probe has attained a vertical direction, care being taken, while so doing, to keep the end which is in the sac pressed firmly against its inner side; the probe, having been brought into a nearly vertical position, should be pushed gently but firmly downwards and slightly backwards and outwards in the direction of the duct; when it has been passed as far as it will go it should be slightly withdrawn, so as to raise its end off the floor of the nose. If the probe has been properly passed down the duct its upper part will remain firmly in contact with the margin of the orbit; but if it moves freely about, the probe is not in the duct, but has been forced through its wall. This little accident is of no particular moment, and needs only that the probe be withdrawn and passed afresh in the right direction.

If the end of the probe is not well within the sac before an attempt is made to pass it down the duct, it may slip backwards into the orbit, or forwards and downwards in the cellular tissue of the cheek. A probe, having been satisfactorily passed, should be left in for about twenty minutes, and the operation be repeated about twice a week. The treatment of stricture of the lachrymal duct is, on the whole, unsatisfactory, but the probing

17

should be carefully and perseveringly carried out. It is well always to commence with the largest probe, No. 6, and try a smaller one if this cannot be passed.

Washing out the lachrymal sac.—For washing out the lachrymal sac a good syringe fitted with nozzles of different sizes is required. One of the nozzles should be fitted to the syringe, which has been previously filled with fluid (water, a weak solution of nitrate of silver, chloride of zinc, &c.), the nozzle should then be passed along the previously slit canaliculus into the sac and the fluid injected; the patient's head must be bent forwards during the injection, or the fluid will run back along the floor of the nose into the pharynx.

Obliteration of the lachrymal sac.—In some cases of obstinate discharge from the sac, especially if dependent on diseased bone, the discharge may be stopped, and the patient made more comfortable by closing up the sac entirely; of course, more or less watering of the eye will remain after the operation, but is far to be preferred to the annoyance of a constant purulent discharge.

Obliteration of the sac may be attempted in any of the three following ways. A free incision having been made into it, and the blood carefully sponged out, its lining membrane may be destroyed—(1) by filling its cavity with a thick paste of chloride of zinc and starch, in equal parts, inclosed in a small piece of lint; (2) by the application of nitrate of silver, or (3) by the galvanic or other cautery. By any of these procedures adhesive inflammation is set up, more or less obliteration of the sac following.

Operations for obliteration of the lachrymal sac are by no means always successful, and may have to be repeated, perhaps more than once, before a satisfactory result is obtained.

THE CONJUNCTIVA.

But few operations are performed on the conjunctiva alone; it is, of course, cut in some of the operations on the eyelids and in that for strabismus, and some others.

Warts are occasionally found on some part of the membrane; they require to be removed with scissors.

Pterygium is a peculiar, somewhat triangular growth, the base of which is situated in the ocular conjunctiva generally near the inner canthus, the apex encroaching more or less upon the margin of the cornea, or passing for a considerable distance upon its surface. The growth is of a reddish color and variable density; it consists of hypertrophied connective tissue.

Pterygium is not common in this country, and when met with is usually found to occur in sailors and others who have been in the East. If it give rise to any inconvenience or threaten to impair vision, it must be removed by operation.

The patient should lie on the couch, the lids be opened by a wire speculum, the growth seized with toothed forceps, and with a cataract knife dissected up from the surface of the cornea. A small portion of conjunctiva should then be removed parallel with the margin of the cornea, and the apex of the growth fixed by a suture in the wound. The eye should be kept bound up for a few days with wet lint and a bandage.

If a pterygium is simply cut off it will, in all probability, grow again, but if transplanted it will shrivel up, and disappear without giving further trouble. A cicatrix always remains upon the cornea after removal of pterygium, so that it must never be allowed to grow over the pupil.

Pinguiculæ are small yellowish growths situated beneath the conjunctiva, generally near the outer and inner margins of the cornea; they are surrounded by a few large bloodvessels, and are occasionally the source of constant irritation, causing the eyes to be bloodshot and uncomfortable. Pinguicula can be removed, if desired, by making an incision over it, turning back the conjunctiva, then seizing the little growth with forceps, and dissecting it away from the parts beneath. The growth having been removed, the conjunctiva should be closed over the wound by a suture, and the eye kept bandaged for two or three days after the operation.

Lipoma is met with as a tumor projecting beneath the upper lid, near the fornix, and often between the superior and external recti muscles; it somewhat resembles a third lid. If the tumor gives any trouble it must be removed by operation, thus: The patient lying on the couch, the lids should be kept as widely open as possible by a wire speculum, an incision made with a cataract knife through the conjunctiva over the tumor, and its most projecting portion seized with toothed forceps and removed with scissors; care must be taken not to drag upon the growth, as it is continuous with the fat in the cavity of the orbit, a greater portion of which might be pulled out. As much of the tumor as is thought necessary having been removed, the conjunctiva should be closed over it with sutures, and the eye bound up.

Nævus occasionally occurs in the conjunctiva; it may be removed by the knife, or destroyed by the galvanic cautery, in the latter case due precautions must be taken to guard the eyeball from injury during the operation, and to prevent as much as possible the evils arising from subsequent cicatrization.

Cancerous ulcers may also be met with; they must be thoroughly extirpated, the eyeball being excised, if necessary.

Cysts containing a clear serous fluid are occasionally met with in the conjunctiva; they must be punctured, when they at once subside, but sometimes re-form, in which case a portion of the cyst-wall must be excised, or a fine seton passed through it.

Cysticercus also occurs, and should be treated by incision of the cyst.

EXTERNAL MUSCLES OF THE EYEBALL.

Strabismus (squint).—"Strabismus is a deviation in direction of the axes of the two eyeballs, in consequence of which the two yellow spots receive images from different objects. In convergent strabismus the two visual lines do not cross each other at the point it is desired to observe; only one of the two, that of the undeviating eye reaches it. Under this deviation not only does the expression of the face suffer from want of symmetry in its most eloquent parts, but the power of vision, at least in one of the eyes, is usually disturbed, and the squinter always loses the advantage of binocular vision." (Donders.)

Strabismus must not be looked upon as a special form of disease; it is in by far the greater number of cases associated with some anomaly of refraction, which, being the primary cause of the deviation, gives rise to the strabismus; other conditions which may induce strabismus will be subsequently considered.

Two forms of squint are commonly met with. 1. Convergent. 2. Divergent. Other rare forms are superior and inferior strabismus; these will receive no further notice.

Convergent strabismus is the most common of all, and is almost always the result of hypermetropia.

Divergent strabismus is usually the result of myopia.

Convergent strabismus, as just stated, is nearly always the result of hypermetropia. The question naturally arises, How does hypermetropia produce it?

The hypermetropic individual must always accommodate strongly when looking at even a distant object; and as the object is brought nearer, the tension of accommodation must be correspondingly increased. As stated on page 225, accommodation is associated with convergence of the visual lines. Now, the greater the degree of convergence the more strongly is the accommodation brought into play; consequently there is an ever increasing tendency on the part of the hypermetropic individual to converge too much, in order to bring his accommodation into the highest possible state of tension. If the convergence of the visual lines be excessive, or if they do not meet in the same point, convergent strabismus results.

The question next arises, Why do all hypermetropic individuals squint? The reason is that if both eyes are of the same refraction, and have equal acuteness of sight, there is always such a desire to maintain binocular vision that the visual lines will remain directed to the same point, even though the eyes are not accurately accommodated for that point, the individual being content with ill-defined retinal images rather than sacrifice binocular vision by increasing his convergence.

But if vision of one eye be less acute than that of the other, or if there be a difference of refraction between the two, the desire for binocular vision is lost, or its value very much lessened, and the necessity for a well-defined image on one retina is immediately felt. The accommodation is put fully on the stretch, and with it the degree of convergence becomes excessive, both visual lines being directed to points nearer to the eyes than that for which they are accommodated, the deviation of the more defective eye being greater than that of its fellow.

TREATMENT.—Slight cases of convergent strabismus, especially if the deviation is not constantly present, but only occasional (periodic squint), may be cured by the use of glasses which accurately neutralize the existing hypermetropia.

In more severe cases division of the internal rectus tendon in one or both eyes is necessary.

It is often difficult to decide whether only one or both eyes shall be operated on.

If it is found that one eye squints habitually and to no great extent, the other being always used for fixing an object, only deviating slightly when it is excluded, and an attempt made to fix with the habitually squinting eye, division of the internal rectus of that eye which habitually deviates alone is necessary.

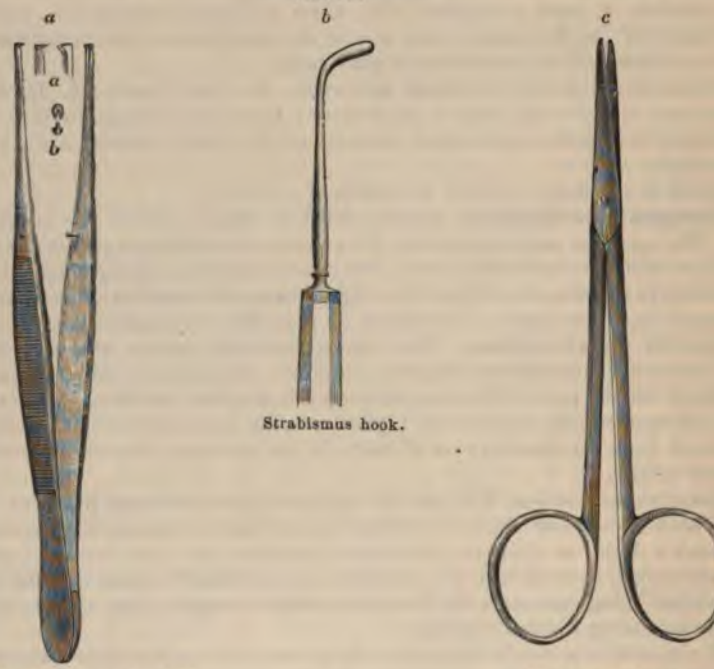
If each eye deviates alternately (alternating strabismus), and to the same extent, division of one internal rectus may be sufficient; but if three weeks or a month after the operation the squint still continues, tenotomy of the internal rectus of the other eye should be performed.

If one eye squints considerably and habitually, the other having an inclination to deviate at times, and if this deviation becomes excessive when the eye is excluded and an object fixed with the habitually squinting eye, the internal rectus in both eyes must be divided. In any case, if there be a doubt as to whether one or both eyes should be operated on, it is well to be on the safe side, and do only one at a time.

Operations for convergent strabismus.—There are two principal methods of operating for convergent strabismus.

1. The operator should stand on the right side of the patient, placed in the usual position (Fig. 94, p. 250), and the eyelids being kept well open with a wire speculum, should seize the conjunctiva and subconjunctival fascia with the toothed forceps (Fig. 99*a*) at a point about midway between the margin of the cornea and semilunar fold, and just below the inferior margin of the tendon of the internal rectus muscle. An incision should then be made with strabismus scissors (Fig. 99*c*) through the conjunctiva and subconjunctival fascia, well down to the sclerotic, and the strabismus hook (Fig. 99*b*) passed through the opening and inserted between the tendon and the eyeball. If properly introduced the hook will be brought up short at the insertion of the tendon into the sclerotic when it is pulled forwards; it should be held firmly in position, the scissors passed through the opening, one blade following the hook between the tendon and the eyeball, the other being kept outside the tendon, which is thus included between the two blades, and the tendon should then be divided by one or two sharp strokes with the scissors.

Fig. 99.



Toothed forceps; *a*, their points shown in side view; *b*, front view.

Strabismus hook.

Strabismus scissors.

The scissors may now be withdrawn, and the hook pulled forwards; if the latter meets with no resistance, but passes freely up to the corneal margin, the operation has been successfully performed; to make sure of this, however, the hook should be withdrawn, the action for hooking the tendon repeated, and any fibres that may have escaped division cut through.

On the division of the tendon the muscle retracts, the retraction being limited by the subconjunctival fascia with which it is intimately connected. If the eye is not properly directed after simple division of the tendon, a greater effect may be produced by further freely severing the subconjunctival fascia.

2. In the second operation, the position of the patient and surgeon should be the same, and the lids be kept open with the wire speculum, as in the one already described.

An incision should be made with scissors through conjunctiva and subconjunctival fascia, over the insertion of the tendon, instead of below its inferior margin; the tendon then picked up with the strabismus hook, and divided close to the sclerotic. The wound in the conjunctiva should be afterwards closed with a fine suture.

No after-treatment is required for strabismus operations; the patient may go about as usual and simply keep the eyes clean. But if, when the eyes have quite recovered from the effects of the operation, there should be any return of the squint manifested, the degree of hypermetropia must be carefully ascertained, and glasses which thoroughly neutralize it ordered to be used for all purposes. In most cases this will be found sufficient; but if, after the glasses have been perseveringly worn for some weeks, no effect is produced, the operation should be repeated in one or both eyes.

Use of anæsthetics in operations for convergent strabismus.—Whether anæsthetics should be employed or not in squint operations appears to be a matter of opinion; some eminent oculists never employing them, others again rarely operating without. For my part, I prefer not to employ an anæsthetic if the patient is pretty steady, but with children and nervous adults I always use one, taking care, however, that a full effect is not produced, and if there is any doubt as to whether one or both eyes are to be operated on, I allow the patient to come nearly to after finishing one eye, so as to ascertain the effect produced by what has been done; if an anæsthetic is given to such an extent as to exert its fullest influence, and produce thorough muscular relaxation, an erroneous idea of the effect of the operation is likely to be formed, and on the return of consciousness the squint may remain as bad as ever.

Other conditions than hypermetropia which may produce convergent strabismus are—

1. Disease of the brain.
2. Paralysis of the external rectus muscle.
3. Inflammatory or other changes in the internal rectus muscle itself, producing shortening.

In the first two of these no operation is advisable; the third may sometimes be remedied by operative interference.

Divergent strabismus, as already stated, is often the result of myopia; it is usually consequent on high degrees of the anomaly, and is brought about as follows: The highly myopic individual requires to bring objects very near the eyes to see them distinctly, consequently a very high degree of convergence is necessary to keep both visual lines directed to the same point; now, not only has a high degree of convergence to be maintained, but in myopia the length of the eyeball and the consequent impairment of its mobility place the internal recti at a disadvantage. Moreover, in order to direct the visual lines of the myopic eyes to the same point, a greater proportionate amount of convergence is required than in emmetropia.

As a consequence, the internal rectus of one eye sooner or later becomes wearied and gives in, and the eye deviates outwards, binocular vision being sacrificed.

TREATMENT.—Many cases of divergent strabismus may be remedied by the use of concave glasses, which enable the individual to see distinctly at a distance up to which convergence of the visual lines can be maintained without undue strain of the internal recti muscles.

If in spite of the use of glasses the divergence continues, it must be remedied by operation. In cases where the eye only deviates outwards, after an object has been looked at for some considerable time, subconjunctival division of the external rectus of the deviating eye may suffice for a cure; but in cases where one or both eyes diverge constantly, and the visual lines can only be made to meet in one point by a great effort, or not at all, the operation of "readjustment" must be performed.

This operation can be performed as follows: The patient being placed in the usual position (Fig. 94, p. 250) and thoroughly anæsthetized, the operator should stand behind, fix the lids open with a wire speculum; with scissors make an incision through the conjunctiva and subconjunctival fascia, below the insertion of the external rectus; hook up the tendon, and divide it subconjunctivally close to the sclerotic.

An incision should then be made through conjunctiva and subconjunctival fascia, about midway between the insertion of the internal rectus and inner margin of the cornea, of such a length as to reach about two lines above and a like distance below the margins of its tendon, which should then be hooked up and divided. The muscle and subconjunctival fascia should be freely separated from the parts beneath, and together with the conjunctiva turned back towards the caruncle. Two curved needles holding fine silk should then be passed through the tissues next the margin of the cornea, and the silks firmly tied, two free ends being left; the needles should then be carried from within outwards, through the muscle, subconjunctival fascia, and conjunctiva, as near the inner canthus as possible, and the silk drawn through; a considerable portion of the muscle and other tissues should then be removed with scissors, the free ends of the two fine pieces of silk and the portions to which the needles are still attached then tied firmly together (the eye being rolled well inwards by an assistant as the knots are pulled tight), and the ends of the two sutures cut off close.

The eye should be bound up with wet lint and a bandage. The sutures will probably require removal in about four or five days, but may be left longer, if they cause no irritation.

Divergent strabismus is met with in cases of paralysis of the third nerve, and may also occur in non-hypermetropic eyes if the sight of one has become much impaired, and binocular vision no longer possible. In the former of these cases no operation is advisable; in the latter no improvement of sight is to be expected from readjustment, but the operation may be performed simply to remedy disfigurement.

THE CORNEA.

The affections of the cornea which require an operation upon the structure itself are six:—1. Sloughing ulcer. 2. Conical cornea. 3. Corneal opacity. 4. Staphyloma. 5. Lodgment of foreign bodies. 6. New growths.

Paracentesis, or tapping the cornea.—This operation is sometimes performed in cases of sloughing ulcer, or suppuration, threatening perforation; by the timely evacuation of the contents of the aqueous chamber a large rupture of the corneal tissue, with its accompanying evils, may in many cases be avoided.

Tapping the cornea may be done thus:—The patient being in the usual position (Fig. 94, p. 250), the operator should stand behind and fix the lids open by a wire speculum or by the fingers. A broad needle should then be passed through the cornea at some convenient part of its margin; when the point of the needle has fairly entered the anterior chamber, its handle should be rotated, so as to bring the breadth of the blade across the incision and thus open it; as soon as the contents of the anterior chamber have flowed out, the needle should be withdrawn, a drop of atropine solution placed between the lids, and the eye bound up in the usual manner.

Iridectomy, however, is to be preferred to paracentesis.

Conical cornea ("Staphyloma corniæ pellucidum"), as the name implies, signifies an alteration in the curvature of the cornea, of such a nature that it assumes the form of a cone. The origin of the affection cannot clearly be traced.

The most prominent symptom is gradually increasing myopia, which cannot be remedied by concave lenses. On looking at the cornea in profile, its conical form is very evident.

On examination with the ophthalmoscope by the direct method the apex of the cone, which may, however, be the seat of some opacity, appears brightly illuminated; around this bright portion is a dark ring corresponding to the sides of the cone, this being again succeeded by an area giving a bright reflection, and corresponding to a portion of the cornea which retains more or less its natural curvature.

Objects occupying the fundus of the eye are seen through the apex and sides of the cone near its base, in an inverted position, as in myopia, whilst we obtain a more or less distinct erect image of the same parts through the portion of cornea which still retains its normal curvature. The retinal vessels appear to have a whirl-like motion as we change our point of view from side to side. The appearance is quite characteristic, and once seen is not likely to be forgotten.

Treatment.—Conical cornea can only be remedied by operative interference; two methods of operating are practised, the object of each being to flatten the cone, and restore to the cornea more or less of its natural curvature.

In one operation an elliptical portion including the whole thickness of the cornea is removed from the apex of the cone. The operation can be performed thus (for the position of patient and operator *see* Fig. 94, p. 250):—An anæsthetic should be given, the lids held open by a wire speculum, and the eyeball fixed by seizing with the toothed forceps the conjunctiva and subconjunctival fascia at some point near the corneal margin. A straight cataract extraction knife (Fig. 103 *c*) should then be thrust through the cone from side to side, a small flap formed by cutting out either upwards or downwards, and the flap so made seized with iris forceps and removed with scissors.

In this operation the anterior chamber is opened and the cornea collapses as soon as the first incision is made. Care must be taken that the portion removed includes the most prominent part of the cone, and that the opening left is exactly opposite the pupil.

After the operation the speculum must be very carefully removed, the lids gently closed and bandaged in the usual way; the eye must on no account be examined for a week, so as to give time for the opening in the cornea to fill up. The wound will, in all probability, heal in the course of ten days, the anterior chamber being restored.

The margin of the pupil is not unfrequently caught up in the incision, an anterior synechia resulting.

The operation described gives the most satisfactory results, the curvature of the cornea being greatly improved, and a corresponding amount of vision regained.

In the second operation a superficial portion only is removed from the apex of the cone with a small trephine, a raw surface being left, which by its subsequent cicatrization and contraction causes considerable flattening of the cone.

Tinting the cornea is called for in cases of dense white opacity (leucoma), causing disfigurement. The operation can be performed as follows:—

For position of patient and operator *see* Fig. 94, p. 250. An anæsthetic having been given, the operator should place the wire speculum between the lids, fix the globe with the toothed forceps, paint some Indian ink upon the opacity, and prick it thoroughly in with a bunch of needles fixed in an ivory handle; the ink should be sponged away from time to time in order to allow the operator to see what progress he has made.

The opacity having been thoroughly tinted, the speculum should be removed; no bandage need be applied, and no after-treatment is necessary; very little irritation follows. If after the lapse of a week or ten days the opacity do not appear sufficiently blackened, the operation may be repeated.

If the ink be allowed to get into the wound made in the conjunctiva by the toothed forceps, a black mark will be left; care should therefore be taken to fix the globe at a point to which the ink cannot run. Should the anterior chamber be opened, the operation must be discontinued, as the lens may be wounded.

Staphyloma, first so-called from its supposed resemblance to a grape, has now come to mean a bulge on any part of the eyeball. On the cornea it is caused either by yielding of its structure or more commonly by prolapse of iris through a perforation in it, the prolapsed portion being firmly coated over with inflammatory material. Staphyloma is said to be "total" where the whole of the cornea is affected, "partial" when some portion of of it retains its normal curvature. Total staphyloma should be removed by abscission (*see* p. 275), or the eyeball may be excised. Partial staphyloma may subside on the performance of iridectomy, or can be removed as follows:—The position of patient and operator should be as at Fig. 94, p. 250, and an anæsthetic should be administered. The lids being kept open by the wire speculum, a curved needle armed with fine silk should be passed through the base of the staphyloma, an elliptical portion of which should then be removed with a straight cataract knife; the silk should then be drawn through and tied, thus bringing the edges of the gap made by the removal of the elliptical portion together, and the eye bandaged in the usual way. The suture may be removed in the course of three or four days.

Foreign bodies.—Small fragments of metal, chips of stone, thorns, &c., are not unfrequently found lodged in the cornea. To remove them the position of patient and operator should be as Fig. 93, p. 250. As a rule, no anæsthetic need be administered. The lids should be kept open by the fore and ring fingers of one hand, and the globe steadied by gently pressing upon it with the second finger; the foreign body should then be carefully lifted from its bed with the point of a knife or small spud held lightly in the other hand. Foreign bodies, especially thorns, are sometimes so firmly and deeply imbedded that they require to be cut out.

New growths may be met with springing from the cornea.

Congenital tumor is a small white flattened elevation usually situated near the corneal margin, encroaching on both cornea and sclerotic; it lies beneath the corneal epithelium and conjunctiva, and appears to extend pretty deeply into both cornea and sclerotic; the growth is present at birth, but usually increases somewhat as the child grows up. It may give rise to astigmatism by causing distortion of the cornea.

The growth may be single or there may be two or three little tumors. Their structure is that of connective tissue, and occasionally small hairs grow upon them.

Should the little growths give rise to inconvenience they can be shaved off level with the cornea, but, as a rule, they cannot be entirely removed.

Round and spindle-celled sarcomata have also been met with growing from the cornea. Such cases usually call for extirpation of the eyeball.

THE IRIS.

Iridectomy is called for in all cases in which it is desirable to influence the tension or nutrition of the eyeball; it is associated with some operations for cataract; in a somewhat modified form, is one of the methods of making an artificial pupil, and is useful in some other conditions.

The operation is performed (1) to influence tension.

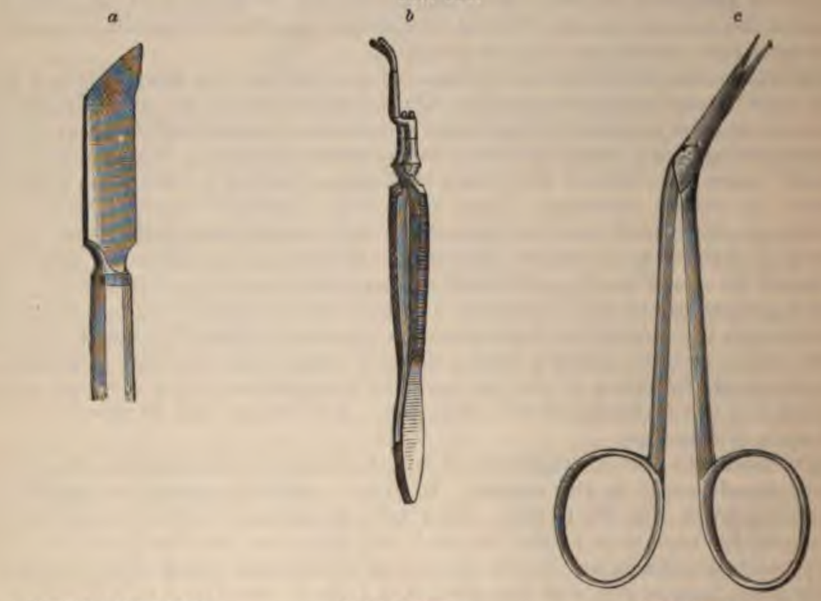
(*a*) *In sloughing ulcers*, or suppuration of the cornea, accompanied by pain, and threatening perforation. In such cases iridectomy gives almost instant relief to the most severe pain, and in all probability will save the cornea from rupture.

(*b*) *In injuries of the eyeball*, in which the crystalline lens, being wounded, has become opaque and swollen, and is pressing on surrounding parts, causing severe pain and threatening the integrity of some of the delicate structures within the globe. In these cases, not only does iridectomy diminish tension, and so relieve pain, but gives room for any subsequent swelling of the lens.

(*c*) *In staphyloma of the cornea* iridectomy often causes complete subsidence of the projection.

(*d*) *In glaucoma* a timely and well-performed iridectomy causes instant and lasting diminution of tension and places the eye in comparative safety; the operation should be performed on any eye that can distinguish *bright* light, and to relieve pain in any case whether there be perception of light or not; in acute glaucoma it must be tried even if all perception have been lost for some days.

Fig. 100.



a. Bent iridectomy knife. *b*. Iris forceps. *c*. Iris scissors.

(2) To influence nutrition, iridectomy should be performed in chronic choroido-iritis, recurrent iritis, and in cases of total exclusion of the pupil, where there is no communication between the anterior and posterior division of the aqueous chamber.

(3) Associated with operations for cataract iridectomy should be performed previous to

a needle operation if much swelling of the lens be anticipated; or it may require to be done after the needle has been used if pain or increase of tension occur.

The operation should also be performed at some time previous to, or simultaneously with, small flap or linear extraction of cataract.

(4) Iridectomy for artificial pupil is mentioned at another page.

(5) Other conditions in which iridectomy may be required are—

(*a*) Hemorrhage into the vitreous humor.
(*b*) Displacement of the retina.
(*c*) As an aid to the removal of foreign bodies from the globe.
(*d*) Some peculiar conditions of intra-ocular circulation.

Operation of iridectomy. *Instruments.*—A wire speculum (Fig. 97), a straight or bent iridectomy knife (Fig. 100*a*), a pair of toothed forceps (Fig. 99*a*), a pair of iris forceps (Fig. 100*b*), iris scissors (Fig. 100*c*), and a curette (Fig. 103*a*). For the position of patient and surgeon *see* Fig. 94, p. 250. The patient should be brought fully under the influence of an anæsthetic, the lids kept widely open by the wire speculum; and the eyeball fixed by seizing the conjunctiva and subconjunctival fascia near the corneal margin with the toothed forceps; then, with a straight or bent iridectomy knife of medium size, an incision should be made in the sclerotic, in such a position that the knife enters the anterior chamber quite at its peripheral part, and close to the anterior surface of the iris.

The knife, having entered the anterior chamber, should be pushed steadily on (care being taken to keep its point well forwards towards the cornea, so as not to wound the lens), until the point is opposite the centre of the pupil. The point should then be turned to one side, so as to be out of the pupillary area, and the knife slowly and gently withdrawn, the hold of the forceps being let go at the same time. The incision thus made should be of such a length as to correspond to a little more than one-fourth of the circumference of the iris.

The next step in the operation is the removal of a portion of the iris. If, as is not unfrequently the case, the iris has become prolapsed, it needs only to be seized with the forceps, and a piece of the desired size removed with the scissors. If the iris does not protrude, the iris forceps should be introduced shut, through the wound in the sclerotic, and pushed on until the extremities of their branches are opposite the nearest portion of the pupillary margin; they should then be allowed to open of themselves, when the iris will be pushed between the branches by the pressure of the parts behind; no backward pressure must be made with the forceps, but they should be gently closed again and withdrawn, carrying the iris with them, which should then be cut across with the scissors, close to one angle of the wound, drawn over to the other angle, and a piece cut off; the curette should be passed between the lips of the wound so as to push back any portions of iris that may have become entangled in it. The eye should then be bound up with lint and a bandage. The form of the pupil after a well-performed iridectomy should resemble Fig. 102 D.

With regard to the position of the portion of the iris to be removed, opinions are at variance. If the surgeon be a skilful and experienced operator, and has the aid of a competent assistant, the iridectomy should be done upwards, so as to place the gap beneath the upper lid, and thus conceal it as much as possible.

To perform iridectomy upwards, a bent iridectomy knife should be used, and the incision made in the sclerotic above the upper margin of the cornea, an assistant should then draw the eyeball downwards with forceps, the iris forceps should be inserted, and the portion of iris removed as previously directed.

An inexperienced operator will find it much easier to remove the portion of iris from its outer and lower segment. In this case a straight iridectomy knife can be used, and no assistant is required. The result is rather an ugly gap; the disadvantage of which, however, is quite counterbalanced by the ease and safety with which the operation can be performed.

Accidents which may happen during the operation of iridectomy, and difficulties which may be encountered.—The accidents which may occur are—

(1) Wound of the lens from insufficient care in keeping the point of the knife well forward, and out of the area of the pupil. This accident will, in all probability, be followed by the formation of traumatic cataract.

(2) Escape of vitreous humor is very likely to occur in hard eyes, if the knife be too quickly withdrawn, or if undue pressure be exerted on the globe with the forceps.

(3) The iris may be torn away from its insertion at a point opposite to the incision, if undue traction be exercised upon it with the iris forceps.

Difficulties.—The iris may be found so rigid that it cannot be seized with the forceps, or so rotten that only very small portions can be brought away; sometimes it bleeds profusely when touched, filling the anterior chamber with blood, and considerably hindering the operation.

Artificial pupil.—The operation for artificial pupil is performed to open a new path for rays of light to the retina, the natural passage being obstructed.

It is indicated in the following cases: (1) In opacity of the cornea, with or without anterior synechiæ. (2) In closure of pupil. (3) In extensive posterior synechiæ. (4) In central opacity of the lens or its capsule.

The artificial pupil must be small, as nearly central and as well defined as possible. Care must be taken to make it behind that portion of the cornea which is most transparent and least altered in curvature, the best situation being ascertained by oblique illumination. The new pupil must not be made upwards, or it will be covered by the upper lid.

An artificial pupil can be made in any of the following ways: (1) By incision of the iris. (2) By tearing it away from its insertion. (3) By excision of a portion (iridectomy for artificial pupil). (4) By ligature.

In operations for artificial pupil the position of patient and surgeon should be the same as in "iridectomy," and an anæsthetic should be administered.

1 (*a*). *Incision* (Fig. 102 A).—This operation is called for in cases of complete closure of the pupil, following removal of the lens, either by operation or injury, but is not advisable unless the lens be absent. In these cases the iris may be found changed into a tense, unyielding membrane, which cannot be seized with forceps.

The operation of "incision" may be performed either by thrusting a broad needle through the cornea near its margin, and then incising the iris, so as to cut across its radial fibres; or an incision having been made with an iridectomy knife in the sclero-corneal margin, a pair of scissors (having one sharp and one blunt-pointed blade) may be introduced through the wound, one blade being thrust through the iris at its nearest point and passed behind it, the other carried along its anterior surface, and the iris then cut fairly across from one side to the other.

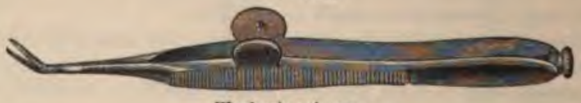
Whichever plan of incision is adopted, the vitreous humor pushes forward into the wound and keeps its edges widely separated, a pupil resembling Fig. 102 A being formed.

Two other methods of making an artificial pupil by "incision" have been lately introduced; they are known as single and double "iridotomy."

For the positions of patient and surgeon in performing either of these operations, see Fig. 94, p. 250.

(*b*) *Single iridotomy* should be thus performed:—The eyelids being kept open with the wire speculum, and the eyeball fixed by seizing the conjunctiva and subconjunctival fascia, close to the margin of the cornea at its inner side, an incision should be made with an iridectomy knife in the cornea, about midway between its margin and the pupil, and opposite to the point of fixation with the forceps. The forceps scissors (Wecker's, Fig. 101) must be then introduced closed through the wound into the anterior chamber, the blades opened, one passed through the pupil behind the iris, the other on its anterior surface, and the sphincter of the pupil be divided with one sharp cut. The scissors should then be withdrawn, any prolapse of iris that follows replaced with the curette, a drop of atropine placed between the lids, and the eye lightly bandaged.

FIG. 101.



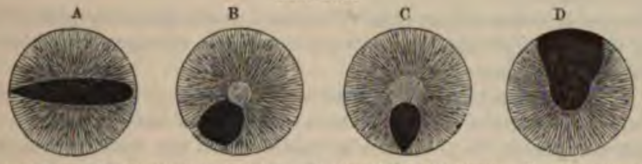
Wecker's scissors.

This operation is applicable to cases where the lens is present, its centre being opaque and its peripheral portion clear.

(*c*) *Double iridotomy* is applicable to cases of closed pupil after cataract extraction. An incision should be made through the upper part of the cornea, the knife carried through the iris and along its posterior surface, so as to make a fair-sized wound in it; the incision being finished the knife should be carefully withdrawn, and, very possibly, some vitreous humor will follow it.

The next step in the operation is to pass the forceps scissors, closed, through the wound in the cornea into the anterior chamber, open them, pass one blade behind the iris, the other in front of it, make an incision in a direction downwards and inwards; then change the direction of the scissor blades and make a cut downwards and outwards. Thus a small piece of iris is inclosed by a V-shaped incision, the apex of the V being upwards. The small portion of iris contracts up, and a somewhat triangular pupil is left. The eye should be bound up as usual.

Fig. 102.



A. Pupil after incision. B. Pupil after excision. C. Pupil after ligature. D. Iridectomy for glaucoma.

(2) **Tearing away the iris from its insertion (Iridodyalisis).**—An incision having been made through the cornea on the side opposite to that on which the iris is to be removed, a pair of iris forceps should be passed through the wound and across the anterior chamber, the iris seized close to its greater circumference, and torn forcibly away from its insertion; the instrument should then be carefully withdrawn and the eye bound up. If necessary, the whole iris may be removed in this way. This operation is applicable to cases of dense corneal opacity (leucoma), occupying the whole of its central part, some transparent cornea being left at the margin.

(3) **Excision—Iridectomy for artificial pupil.**—An incision should be made of the requisite size, through some part of the sclero-corneal margin, the iris forceps introduced through the wound, the ends of their branches passed fairly up to the margin of the pupil, the iris seized and drawn out through the wound, and a small portion removed with scissors. The curette should then be passed between the lips of the wound so as to push back any portion of iris that may have become entangled in it; a pupil resembling Fig. 102 B should be formed.

(4) **By ligature (Iridodesis, or Iridesis).**—An incision should be made with a broad needle near the margin of the cornea, a small noose of silk laid upon the surface of the eyeball so as to encircle the incision; an iris hook or canula forceps then passed through the noose and wound, and the iris drawn gently out; an assistant with two pairs of broad-ended forceps should seize each end of the noose and firmly ligature the included portion of iris; the ligature will drop off in the course of a few days, a pupil resembling in shape Fig. 102 C being left.

THE CRYSTALLINE LENS.

Cataract.

By cataract we understand an opacity of the crystalline lens.

The causes of this opacity are somewhat obscure, but it probably depends on impairment of nutrition of the lens consequent on senile decay or constitutional conditions (*e. g.*, diabetes).

It also occurs in connection with inflammatory changes in adjacent parts—the choroid, ciliary body, vitreous, and iris; is met with as a congenital defect, and very frequently results from injury.

Forms of Cataract.

There are two principal forms of cataract:—

(1) *The cortical or soft cataract.*
(2) *The nuclear or hard cataract.*

In the first form the cortical substance of the lens is primarily affected, the nucleus afterwards becoming opaque, the whole being soft, or even fluid.

In the second the nucleus of the lens first becomes hard, yellowish, and opaque, the cortical substance being subsequently affected.

The cortical cataract is met with as an idiopathic disease in childhood and early adult life, and as the result of injury at all ages.

There are several varieties of cortical cataract.

(*a*) *Zonular or lamellar cataract* is either congenital or commences soon after birth; it is characterized by an opacity of circular form and well-defined outline, situated in the cortical substance of the lens, but at some distance from its surface; the margin, nucleus and superficial layers of the lens are transparent.

(*b*) *Ordinary congenital cataract* is a bluish-white opacity of the whole lens.

(*c*) *Traumatic cataract* is an opacity of the lens often accompanied by swelling, and caused by rupture of its capsule from injury, and the subsequent action of the aqueous humor upon its substance.

(*d*) *Posterior polar cataract*, an opacity situated at the posterior pole of the lens; and—

(*e*) *Entirely fluid or diffluent cataracts* are caused by changes in the lens, secondary to inflammation of adjacent parts.

The variety of cataract met with in diabetes is composed principally of soft material; but if the patient be advanced in years, there is usually a hard nucleus.

Nuclear cataract occurs in persons who have passed the middle period of life, and is characterized by the presence of a hard yellowish central portion or nucleus of varying size and density; the nucleus is surrounded by more or less soft cortical substance, and is occasionally of a greenish, or almost black color, giving rise to what is known as *green or black cataract.*

Diagnosis of cataract.—The existence of cataract is easily ascertained by oblique illumination, the pupil having been dilated with atropine previous to making the examination.

TREATMENT.—The treatment of cataract is entirely operative, no kind of medication being of the least use.

Our object in performing an operation is to open a path for rays of light to pass to the retina. This can be attained in one of two ways, the method adopted depending on the kind of opacity present.

(1) In cases (as lamellar cataract) where the bulk of the lens is clear, the opacity being situated in the axis of the normal pupil, very useful vision is procured by making an artificial pupil, opposite a transparent portion of the lens (*see* Artificial Pupil).

(2) When the whole lens is opaque, its entire removal must be accomplished.

Three varieties of operation are performed to secure the removal of the whole lens:—

(1) The operation for solution or absorption.
(2) Extraction.
(3) Suction.

Forms of cataract to which each operation is applicable.—As a broad rule, cataract occurring in persons below twenty is of the soft or cortical form, and should be removed by *solution* or *suction;* cataract occurring in persons above thirty (excepting traumatic cataract) is of the hard or nuclear form, and must be removed by extraction.

In the intermediate decade a doubt may arise as to what is the best plan of procedure; in these cases the surgeon must be guided by the general appearance of the cataract; if it appears bluish in color, and somewhat swollen, it is probably soft and can be removed by *solution* or *suction;* if there is a distinct yellow reflection from its centre, denoting the presence of a hard nucleus, it should be removed by *extraction.* It must also be borne in mind that loss of time is a very serious consideration with most patients, consequently a preference must always be given to that operation which will allow him to resume his occupation as early as possible.

Solution, though perhaps somewhat safer than extraction, is always a tedious process, and the more so the older the patient; consequently, preference must be given to extraction in all cases where the condition of the patient's sight is such as to prevent him following his occupation, even though there be no appearance of a hard nucleus. In cases where the cataract is evidently soft, and one eye retains useful vision, solution is to be preferred to extraction, as the patient can continue at his work during the time that absorption is going on.

Before performing any operation for cataract we must take care to ascertain that the eye has good perception of light, indicating that the retina is in a normal condition; otherwise no improvement of vision will result from removal of the lens.

OPERATIONS FOR REMOVAL OF CATARACT.

Solution.—In the operation for solution the capsule of the lens is opened, and its substance thus allowed to be acted upon by the aqueous humor, by which it is broken up and softened, absorption finally taking place.

The operation can be performed as follows (for the positions of patient and operator *see*

Fig. 94, p. 250): No anæsthetic is needed; the pupil should be well dilated with atropine; the operator, keeping the eyelids separated by the fore and ring fingers of one hand, and steadying the globe by pressing the second finger gently upon it, should take a cataract needle in the other hand and pass it obliquely through the cornea at such a distance from its centre that any resulting cicatrix will not interfere with vision; the needle should then be pushed on across the anterior chamber into the area of the pupil; its point then depressed and three or four incisions made with it in the lens-capsule, so as to divide it freely. Care must be taken to use the needle very gently, and not to pass it too deeply into the lens, otherwise the suspensory ligament may be torn and the lens displaced.

The capsule having been freely divided, the needle should be carefully withdrawn and a drop of solution of atropine placed between the lids; the only after-treatment required is the constant use of atropine, so as to keep the pupil widely dilated.

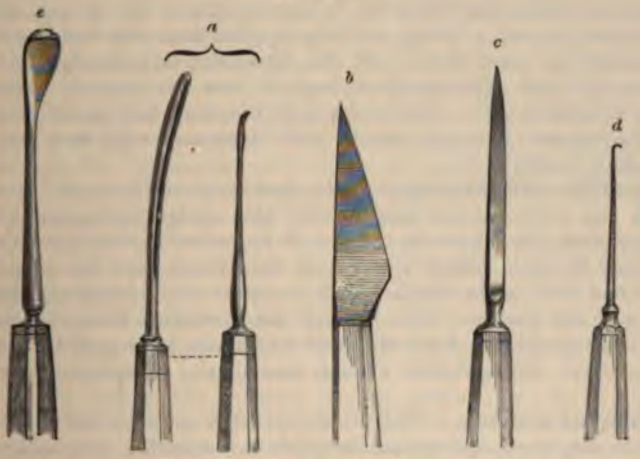
If the eye be examined in the course of a few days white flocculent lens matter will be seen protruding through the opening in the capsule into the anterior chamber, showing that the lens is swelling and undergoing solution.

The operation will probably require to be repeated in about a month or six weeks, and possibly on one or two subsequent occasions, before the whole lens is absorbed. Care must be taken not to do too much at one sitting, or the lens may swell too rapidly and press upon the surrounding parts, giving rise to severe pain, increased tension of the globe, iritis, cyclitis, &c.

Extraction of cataract.—The object of operations for extraction of cataract is the removal of the lens through an incision altogether in the cornea or partly in the sclero-corneal margin or sclerotic, the incision being either simple or associated with excision of a portion of iris.

Extraction can be best performed by one of the five following methods: (1) Flap extraction, (2) small flap with iridectomy, (3) extraction by oblique corneal section, (4) linear extraction, (5) extraction by means of a traction instrument. In the first and third methods no iris is removed; in the second, fourth, and last iridectomy should be performed either at the time of removal of the lens or some weeks or months previously. All entirely opaque lenses (mature cataracts) may be removed by the first or third methods; all partially opaque lenses (immature cataracts) must be extracted by the second or fourth, a traction instrument being used in any case where great difficulty is encountered, or where escape of vitreous has taken place before the lens has been extracted.

FIG. 103.



Instruments for extraction of cataract.
a. Curette and pricker. *b.* Triangular cataract knife. *c.* Straight cataract knife (Graefe's).
d. Sharp hook. *e.* Scoop.

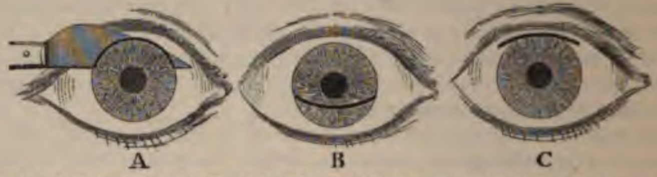
We shall, however, find that in all cases we obtain most uniform success by extraction associated with iridectomy; we should never attempt to extract an immature cataract without first excising a portion of iris, and it is well to do so as a preliminary some weeks before the lens is removed.

Flap extraction.—The instruments required for flap extraction are a triangular cataract knife, sharp hook, and curette (Fig. 103, *b*, *d*, *a*).

For the positions of patient and operator *see* Fig. 94, p. 250. No anæsthetic is required; the patient should be requested to look downwards, the lids kept open and the eyeball steadied by the operator's fingers as in the operation for solution.

The incision should be made by passing a triangular cataract knife through the outer margin of the cornea, at a point just above its horizontal meridian, into and across the anterior chamber, bringing it out through the cornea at a corresponding point on the inner side, and completing the section by pushing the knife onwards until its heel cuts out along the upper margin of the cornea. (Fig. 104 A.)

Fig. 104.



Incisions for extraction of cataract.—A. Flap. B. Oblique corneal section. C. Linear incision.

This simple onward movement of the knife is sufficient if the incision has been properly planned, but should the cornea have been entered too low down, the knife will not be wide enough to cut out, and then the section must be completed by slightly withdrawing the blade or by a sawing movement. Care must be taken not to withdraw the knife until it has passed some distance through the opposite side of the cornea, or the aqueous humor will escape too soon, and the iris fold over the edge of the knife and be wounded.

If the incision has been properly made a semicircular flap, including a little less than half the cornea, will be formed.

The section having been finished, the patient should close the eyes gently, and be allowed to rest for a moment.

The next step in the operation is the removal of the opaque lens. The upper lid being drawn gently upwards and the patient directed to look downwards, the sharp hook must be introduced through the wound and the lens capsule lacerated by gently scratching it; the hook should then be withdrawn, and the patient allowed to close the eyes for a short time.

The eyes should then be gently opened, and the lens removed by lightly pressing the lower lid against the globe, just below the inferior margin of the cornea, with the thumb of one hand, counter-pressure being similarly applied with the forefinger of the other hand at a corresponding point above. If the manœuvre be properly executed the pupil gradually dilates, the lens slips gently through it into the anterior chamber, and then escapes by the corneal wound. Any prolapse of iris that may occur must be carefully returned with the curette; each eye should then be covered with two pieces of wet lint, and a light bandage applied.

Small flap with iridectomy.—A flap section should be made by transfixing the eyeball through the sclero-corneal margin with the straight extraction (Graefe's) knife (Fig. 103 *c*), and then cutting out in the line of the sclero-corneal junction.

The section may be made either upwards or downwards, and the point of transfixion should be about one third of the distance from the horizontal corneal meridian to the upper or lower margin of the cornea. The steps of the operation, with the exception of the incision, are exactly similar to those of linear extraction (see p. 271), but should it be thought fit to perform the operation without anæsthesia, no speculum or fixing forceps should be used.

Oblique corneal section.—This operation often goes by the name of Bader's or Liebreich's operation, when the section is made downwards; Lebrun's "extraction by small median flap," when the section is made upwards. It seems to me that the term "oblique corneal section" expresses all and dispenses with much unnecessary prolixity.

The instruments required are a thin straight cataract knife, a sharp hook, and curette (Fig. 103 *c*, *d*, *a*). (For the position of patient and surgeon *see* Fig. 94, p. 250.) No anæsthetic is required, and, with the exception of the incision, the steps of the operation are much the same as in flap extraction.

The incision may be made either upwards or downwards (Fig. 104 B), by passing the straight knife through the sclero-corneal margin on the outer side at a point (puncture) corresponding to the horizontal corneal meridian into and across the anterior chamber, out at a corresponding point on the inner side (counter-puncture), and then cutting forwards by a sawing movement, *obliquely*, through the cornea, midway between the pupil and upper or lower corneal margin; the former if the incision is made upwards, the latter if it is made downwards. In entering the knife and passing it across the anterior chamber, care must be taken to keep its edge directed forwards towards that part of the cornea which it is desired to incise; if the knife be rotated in any way after the anterior chamber has been opened, the aqueous humor will escape and the blade become entangled in the iris.

The capsule should be lacerated and the lens removed in the same way as in flap extraction; the position of the incision near the centre of the cornea, however, will not allow the lens to be pressed out immediately, as is done in the flap operation.

Before attempting to squeeze out the cataract its margin must be brought opposite the incision by gently pressing upon the globe above or below, according as the section has been made upwards or downwards.

The bulk of the cataract having been removed, care must be taken to get away any soft cortical substance or fragmens of lens that may be left. The soft matter can be removed by gently rubbing the cornea; small hard fragments must be drawn out by the curette or a small scoop. The whole of the cataract having been removed, the iris, which will in all probability have somewhat prolapsed, must be replaced with the curette, and both eyes carefully bandaged.

Linear extraction.—In this operation the cataract is removed through a linear incision, partly in the sclerotic and partly in the cornea, or altogether in the former; usually associated with iridectomy, performed at the time of extraction of the cataract, or some months previously.

By linear incision is generally understood an incision made in the same direction as a straight line drawn from the centre of curvature of the cornea to its circumference (one of its radii). Many modifications of linear incision are practised, but only one will be described here. The instruments required for linear extraction are a wire speculum (Fig. 97), toothed forceps (Fig. 99*a*), a straight cataract knife, a curette, sharp hook (Fig. 103 *c*, *a*, *d*), iris scissors, and iris forceps (Fig. 100 *b*, *c*).

The operation should be performed thus, and, as in the other forms of extraction, the incision may be made either upwards or downwards (for position of patient and operator see Fig. 94, p. 250):—The patient should be thoroughly anæsthetized, the lids kept open by a wire speculum, and, supposing the incision to be made upwards, the globe must be drawn gently downwards with the toothed forceps, holding the conjunctiva and subconjunctival fascia close to the lower margin of the cornea; then with the straight cataract knife puncture and counter-puncture should be made in the *sclerotic*, just beyond the sclero-corneal margin, the knife entering at a point on the outer side of the globe, situated about two thirds of the way between the horizontal meridian of the cornea and its upper margin, and emerging at a corresponding point on the inner side; the edge of the knife should then be directed nearly straight forwards, and by a sawing movement made to cut its way out through the cornea, at a short distance from its upper margin. (Fig. 104 C.)

If iridectomy has not been previously performed, a piece of the iris should next be excised from the upper segment. (*See* Iridectomy.)

The next step is to lacerate the capsule. The operator should fix the eye, and draw it gently downwards with the toothed forceps, then introduce the sharp hook through the incision and freely lacerate the capsule with it. The cataract can then be removed by making gentle pressure with the curette upon the eyeball, near the lower margin of the cornea, the globe being steadied and held in position by fixing the conjunctiva with the toothed forceps.

The nucleus and bulk of the cataract having escaped, the curette should be passed gently over the surface of the cornea from all directions towards the incision, so as to press out any cortical substance that may be left, and if any blood or portions of lens remain in the incision they must be carefully removed, so as to insure perfect coaptation of its margins; the speculum should then be removed, and both eyes bandaged in the usual way.

The incision for linear extraction, as already stated, may be made downwards as well as upwards, the former method of operating being much the easier, and not requiring the aid of an assistant.

The same objections apply to extraction downwards as to iridectomy in the same direction, but the results obtained are equally good as from upward sections and the ease with which the operation can be performed quite counterbalances any objections which may be made on the score of disfigurement.

[illegible] of cataract by a traction instrument.—Cataract can be re- [illegible] either through a flap section or a linear incision peri- [illegible] being performed in either case.

[illegible] anæsthetized, and, whichever incision is made, the [illegible] with the speculum, and the globe fixed with the toothed for- [illegible] during the subsequent removal of the lens.

[illegible] is either a scoop or a sharp hook (Fig. 103 *c*, *d*).

[illegible] by the scoop (scoop extraction).—Scoop extraction [illegible] The section having been made and iridectomy performed, [illegible] should be pressed gently upon the more peripheral margin [illegible] to gape somewhat; the instrument should then be passed [illegible] through the incision, beneath the margin of the lens, along its [illegible] posterior pole, until the lens lies well in its concavity, and [illegible] withdrawn, carrying the cataract with it, the removal being [illegible] on the exterior of the globe.

[illegible] with the Sharp Hook (Sharp-hook Extraction).

[illegible] behind the lens in the same manner as the scoop, fixed [illegible] then carefully withdrawn, carrying the lens with it. Two [illegible] of one, and should be fixed into the lens at different points, so as to prevent it rolling round (as sometimes happens when only one hook is used), instead of passing in the desired direction.

After removal of the lens by either method both eyes should be bound up in the usual way.

Suction.—The removal of the cataract by suction is indicated in cases where the lens has become nearly or entirely fluid, as occurs in many instances of traumatic cataract, and frequently after a needle operation has been performed.

The instruments required are a wire speculum, toothed forceps, broad needle, and suction tube (Figs. 97, 99 *a*, 103 *a*, *b*). Before operating, the pupil should be well dilated with atropine. (For position of patient and surgeon *see* Fig. 94, p. 250.)

It is best, but not absolutely necessary, to place the patient under the influence of an anæsthetic. The lids should be kept open by a wire speculum, the eyeball fixed by the toothed forceps, and a small linear incision made in the cornea with the broad needle, about midway between its summit and margin, in any convenient position.

The operator should then place the mouth-piece of the suction tube in his mouth, pass its nozzle through the incision and behind the softened lens, and, by sucking gently, remove as much lens matter as will come away easily. No force must be used, and if any portion of the lens be too hard to pass easily into the tube it may be left to become absorbed or be dealt with on a future occasion. When as [illegible] come away has been extracted, the suction tube should be re- [illegible] taken out, a drop of solution of atropine placed between the lids, [illegible] in the usual way. The bandage should be continued, and the [illegible] with atropine, until all irritation has subsided.

[illegible] during Extraction of Cataract.

[illegible] escape of aqueous humor.—If care be not taken in making the [illegible] humor may escape too soon, and the movements of the knife be hamp- [illegible] forwards. Should this happen, the knife must be carefully with- [illegible] completed with scissors.

[illegible] the anterior chamber.—In some cases hemorrhage from the cut iris takes place to such an extent as to fill the anterior chamber with blood and hide the cataract entirely from view.

If the blood does not flow out easily on placing the curette between the lips of the incision and making gentle pressure on the cornea the operation should be discontinued, the eye bound up, and left till the blood has become absorbed, unless the lens-capsule has been lacerated, in which case the lens *must be removed at all risks*, or it may swell, press upon surrounding parts, set up inflammatory action, cause increase of tension of the globe, and very probably lead to destruction of the eye.

Prolapse of Vitreous Humor.—If any undue pressure be exerted on the globe during extraction the suspensory ligament of the lens gives way and a prolapse of vitreous follows. Should the prolapse of vitreous occur before the escape of the lens the cataract should be removed as quickly and gently as possible by the aid of a scoop or sharp hook.

Prolapse of vitreous is more likely to occur if the humor is abnormally fluid. The accident may give rise to no bad results, but is sometimes followed by a form of chronic choroiditis which ultimately destroys the eye.

If vitreous has been lost great care must be taken to bandage the eye so as to keep the lids immovable and prevent them pressing upon the globe and causing further prolapse.

Displacement of the Cataract.—In some cases, on an attempt being made to press out the lens, the suspensory ligament gives way, and the cataract, instead of coming forwards into the anterior chamber, passes behind the iris or sinks backwards into the vitreous chamber; it should, if possible, be removed by the scoop or sharp hook. If left within the globe it will probably act as a foreign body, set up inflammation, and destroy the eye.

After-treatment of Extraction of Cataract.

Immediately after the operation each eye should be covered with two folds of wet lint secured by a bandage, which has been contrived for the purpose by Mr. Dunnage,[1] of the Central London Ophthalmic Hospital. The patient should then be put to bed, where he should remain for three or four days.

The lint must be kept constantly wet, and fresh pieces should be applied every two or three days.

On no account should the eye be examined until the end of the first week; if the lids remain in a normal condition we may rest assured that all is going on well, and opening the eye too early can do no good, and may do a great deal of harm.

At the end of a week the eye may be opened and its condition ascertained. Should the section be healed, the anterior chamber re-established, and no signs of inflammatory action present, the sound eye can be safely left uncovered, the one that has been operated on being kept bandaged as before, and a large green shade worn over both. At the end of three weeks the bandage may be removed from the eye on which extraction has been performed, but the shade or protectors should be worn until all undue vascularity has subsided.

At the end of about two months (if there be no intolerance of light or irritability of the eye) glasses should be ordered, two pairs being given; one for going about, and one for reading; convex 13 D will usually be found most suitable for the former purpose, convex 16 D for the latter. But should the patient have been myopic or hypermetropic before the operation, glasses weaker or stronger than these may be required.

This is the usual course of cases of extraction of cataract; all do not, however, go on so favorably.

A day or two days after the operation the patient may complain of severe pain in the eyeball, temple, and brow, and on removing the bandage the lids may be found puffy and red, or perhaps much swollen.

These symptoms always indicate inflammatory changes in some of the ocular structures; the inflammation may be simply an attack of iritis, which will probably proceed to a favorable termination; but may subsequently affect the choroid, a chronic form of choroido-iritis being set up, which leads to softening, and eventually to shrinking of the globe; the cornea may be inflamed or suppurating, or inflammation and suppuration of all the ocular structures (panophthalmitis) may have set in. For the treatment of these cases *see* Iritis, Corneitis, &c.

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[1] Dunnage's bandage consists of a piece of material of an open texture—through which water will easily run—of such a length as to cover both eyes, and leave some to spare. To each end of this piece are attached tapes by which the bandage is secured.

A not uncommon cause of pain and irritation is the occurrence of entropion of the lower lids; this must be remedied by operation (*see* Operations on the Eyelids).

CAUSES OF UNSATISFACTORY RESULTS OF CATARACT EXTRACTION.

The result of an operation for extraction of cataract may be marred by closure of the pupil consequent on iritis, by obstruction of its area with opaque lens capsule, or by opacity of the vitreous humor.

Occlusion of the pupil should be remedied by making an artificial one (*see* Artificial Pupil); capsular obstructions should be torn through with cataract needles, cut across with scissors, or removed bodily with forceps.

The greatest caution must always be exercised in meddling with opaque capsule, as an operation upon it, especially an attempt to tear it forcibly away, is very likely to be followed by increase of tension, inflammation, or even suppuration of the eyeball.

For opacity of the vitreous humor nothing can be done.

EXTIRPATION OF THE EYEBALL.

Removal of the eyeball is called for under the following conditions:—

(1) In all cases of injury causing complete disorganization, with collapse of the globe and escape of its contents.

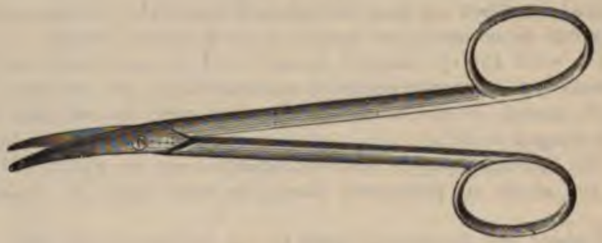
(2) In cases where one eye, having been damaged by injury or disease to such an extent as to render it *practically useless*, becomes irritable or painful, and the sound eye appears threatened by sympathetic ophthalmia.

(3) In cases where an eye lost from injury or disease, and *quite blind*, is a source of annoyance, even though the other eye be not threatened.

(4) In cases where the globe has become the seat of malignant disease.

Extirpation of the eyeball should be thus performed (for position of patient and operator *see* Fig. 94, p. 250): The instruments required are a wire speculum, toothed forceps, a pair of blunt-pointed scissors, curved on the flat (Fig. 106) and a strabismus hook.

FIG. 106.



Extirpation scissors.

The patient being thoroughly under the influence of an anæsthetic, the operator should place the wire speculum between the lids, then by the aid of the forceps and scissors cut through the conjunctiva all round the cornea as close to its margin as possible; he should then, with the strabismus hook, take up the four recti muscles, one after the other, and divide them with the scissors, either the external or internal rectus being cut at a little distance from the globe, so as to afford a hold for the forceps in the subsequent steps of the operation, and the other three muscles as close to it as possible.

The muscles having been divided, the hook should be made to sweep round the globe, so as to be sure that nothing is left uncut. By pressing the speculum backwards the eyeball will become dislocated in front of the lids, and then being steadied by holding the piece of muscle purposely left, with the forceps, the scissors should be passed behind it until their points are found to be in contact with the optic nerve, then slightly withdrawn, opened widely, pressed forwards again, and the nerve divided by a single cut.

As soon as the nerve has been cut through, the eyeball will be almost free, being held only by the oblique muscles, which should be divided close to the sclerotic. Should there be free hemorrhage the speculum may be left between the lids, a piece of sponge pressed firmly into the orbit, and secured by a turn of bandage; when all bleeding has ceased the sponge should be removed with the speculum, and two small pads of wet lint and a bandage applied. Should the hemorrhage be but slight two or three small pads of wet lint must be laid over the closed lids, and secured by a bandage in the same manner as in other operations on the eye. In about a month or six weeks an artificial eye may be ordered.

ABSCISSION

Abscission is the removal of that portion of the eyeball (including the ciliary region) situated in front of the attachments of the recti muscles, these being left intact. The object of this operation is to leave a movable stump, on which an artificial eye can rest and be moved in harmony with the movements of the sound one.

Abscission is indicated in staphyloma occupying the whole or greater part of the former situation of the cornea, the remainder of the globe retaining its normal curvature.

The operation should be thus performed (for position of patient and operator *see* Fig. 94, p. 250): The instruments required are a wire speculum, toothed forceps, strabismus scissors, a triangular cataract knife, a curved needle and silk. The patient being thoroughly under the influence of an anæsthetic, the wire speculum should be placed between the lids, the conjunctiva divided all round close to the corneal margin (as for extirpation), and dissected back to the desired extent.

Then with the curved needle a single suture should be passed from side to side across the front of the eyeball through both edges of the divided conjunctiva, and the silk left hanging in a large loose loop on the patient's face.

The staphyloma, the whole of the ciliary body, and sclerotic corresponding to it, should then be removed by transfixing the globe with the triangular knife just in front of the insertions of the internal and external recti muscles, cutting out upwards in front of the insertion of the superior rectus, and finishing the removal by a sweep of the knife in the opposite direction.

The silk should be then drawn up and tied, by which means the conjunctiva will be made to cover the wound in the globe, and wet lint and a bandage applied. As soon as the parts have firmly healed an artificial eye may be worn.

Abscission should be performed in preference to excision of the globe in children; the presence of the stump left prevents to a great extent the shrinking, or non-development, of the orbit which will occur if the eyeball be removed entirely.

In older persons excision is generally to be preferred, as the stump left after abscission is very liable to become troublesome, and in the very old is prone to suppurate.

AFFECTIONS OF THE ORBIT.

Protrusion of the Eyeball.—As many of the diseases of the orbit, and to a considerable extent tumors of the eyeball itself, cause more or less protrusion of the globe, it will be well to say a few words on this subject before describing the morbid changes which may give rise to it.

The symptoms are obvious enough, and do not require description. The causes are the following:—

1. Inflammation within the orbit, either with or without the formation of abscess.
2. Hemorrhage into the orbit.
3. Vascular protrusion of the eyeball.
4. Exophthalmic goitre.
5. Tumors within the orbit, nodes, exostoses, malignant growths, cysts, nævi, &c.
6. Enlargement of the eyeball itself from (*a*) growths, malignant or simple; (*b*) inflammation and suppuration of the whole eyeball (ophthalmitis).
7. Paralysis of its muscles, allowing the globe to drop forwards, and thus assume an unusual prominence.

Double vision is *generally* complained of in protrusion of the eyeball. The ill effects of the abnormal position are seen both in the globe itself and in the lids. Should the protrusion be so great that the lids cannot be closed over the eyeball the cornea will be left unprotected and may become opaque, and afterwards ulcerate or slough. If the protrusion continue for long the lids become distended and flaccid, their movements being much impaired; the tear puncta may also become displaced, giving rise to continual watering of the eye.

TREATMENT.—In all cases where the eyeball is healthy care should be taken to protect the cornea from injurious exposure by drawing the lids over it and keeping them fixed by

[illegible] the edges of the lids must be pared, united
[illegible]

[illegible] —Inflammation may affect the soft tissues within
[illegible] it may end in resolution, the parts returning
[illegible] may result, causing more or less permanent
[illegible] of the eyeball; or abscess may form, and in
[illegible] necrosis of the bony walls may supervene.

[illegible] orbit is accompanied by more or less febrile
[illegible] much increased by pressure, swelling of the
[illegible] prominence and impaired movement of the eyeball,
[illegible] the eye; it may be the result of cold, injuries, or
[illegible] in the case of periostitis) of syphilis, or may come on
[illegible] during recovery from acute diseases (scarlet fever,
[illegible] It is not easy to distinguish inflammation affecting
[illegible] of the periosteum or bone.

[illegible] allaying pain and inflammation by means of opium
[illegible] to the affected part, leeches to the corresponding
[illegible] and rest in bed in a darkened room; any general medical
[illegible] applicable should also be employed.

[illegible] be strong and healthy, low diet, purgatives, &c., should be
[illegible] during recovery from some acute disease, tonics and good
[illegible] Should the patient be the subject of syphilis this should be
[illegible]

[illegible] go on to the formation of **abscess,** the symptoms are
[illegible] becomes more swollen, and in some cases almost covers the
[illegible] swollen and red, the prominence and impairment of movement
[illegible] rigors may occur. Vision becomes misty, and in some cases
[illegible] entirely lost. After a time fluctuation may be detected; if left
[illegible] will burst, the pus being discharged either through the skin or
[illegible] having been emptied, in favorable cases the swelling will
[illegible] its natural position, and the opening heal. But in some
[illegible] suppuration be associated with caries and necrosis of the bone, the
[illegible] or the orifice alone heal, the sac again becoming filled with pus.

[illegible] as soon as the surgeon feels satisfied of the existence of pus in the orbit
[illegible] fluctuation can be detected the diagnosis is easy enough, but
[illegible] and suppuration is suspected, an exploratory puncture should
[illegible] of pus will clear up any doubt.

[illegible] opening an abscess in the orbit is that recommended by Mr. Hilton
[illegible] at a depth from the surface amongst important structures.
[illegible] be performed as follows:—An incision having been made, either
[illegible] conjunctiva, at that part where the eyeball appears most thrust away
[illegible] orbit, a grooved director should be thrust in (the surgeon bearing in
[illegible] the wall along which he is passing the instrument and the depth of
[illegible] As soon as pus is seen escaping along the groove of the director a pair of
[illegible] should be passed along it until their points are within the abscess;
[illegible] be separated slightly and drawn out whilst so separated; a ragged
[illegible] which is not likely to close too soon, and the danger of cutting
[illegible] will be obviated.

[illegible] must always be taken not to injure the eyeball. As the operation is
[illegible] anæsthetic should be given.

[illegible] the operation search should be made by means of a probe for diseased
[illegible] if a foreign body or loose sequestrum be detected it should be at
[illegible] diseased bone, if still firm, may be left to itself, and will either come away
[illegible] require removal at a later period. If the opening appear inclined
[illegible] it should be kept open by means of a piece of lint passed into it; only
[illegible] need be applied.

[illegible] ostitis followed by caries and necrosis of the walls of [illegible] [illegible]—The symptoms of periostitis or ostitis going on to caries or
[illegible] to those above described, excepting, perhaps, that the pain is more
[illegible] aggravated at night. This form of inflammation should always be sus-
[illegible] suffering from syphilis, and occasionally nodes may be met with at the
[illegible] or on the forehead; their existence should always lead the surgeon to

suspect that the inflammation within the orbit is periosteal. When the abscess has formed and burst, or has been opened, the seat of inflammation becomes evident from the character of the pus, which is of that peculiar unhealthy and bad-smelling variety met with in abscesses connected with diseased bone, as well as from the condition of the opening, which remains patent and is surrounded by large unhealthy granulations, and from the fact that the bare bone can be felt with a probe passed through the opening.

Caries and necrosis usually end in recovery after a time, the diseased bone being thrown off and the sinus becoming closed. The disease generally attacks the margin of the orbit and often leaves cicatrices, which cause great disfigurement and deformity of the eyelid. Should caries or necrosis occur deeply in the orbit the results may be most serious, the optic nerve becoming affected and vision lost, or the disease may spread to the interior of the skull, set up meningitis, and cause death.

TREATMENT.—In the earlier stages the treatment should be the same as that described under inflammation and abscess of the orbit, but when the abscess has burst, or been opened, its cavity should be syringed out daily with some mild disinfecting solution; care must be taken to prevent its too early closure, by means of a piece of lint pushed into the sinus; exuberant granulations should be kept down by the application of nitrate of silver, and distortion of the lids, if likely to occur, must be prevented by uniting their edges (*see* Operations on the Eyelids).

If any pieces of bone are found loose they should be removed by operation.

Hemorrhage into the orbit.—Orbital hemorrhage may depend upon the spontaneous rupture of a vessel within the orbit, and should it be considerable, may produce displacement of the eyeball. The blood may become diffused, and appear beneath the conjunctiva, being subsequently gradually removed by absorption; occasionally, however, the clot becomes encysted, and permanent displacement of the eyeball results. Hemorrhage into the orbit also occurs in fracture of its walls frequently to a considerable extent; subconjunctival ecchymosis being a prominent symptoms in some cases of fracture of the base of the skull extending through the roof of the orbit.

Hemorrhage sufficient to cause displacement of the eyeball has occurred after the operation for strabismus.

TREATMENT.—In cases of spontaneous hemorrhage, light pressure should be applied to the eye by a pad of lint or cotton wool and a bandage. Where excessive hemorrhage occurs after operations for strabismus a large pad of lint should be placed on the closed lids, and firm pressure by means of a bandage kept up for a few hours after the operation. Hemorrhage from fracture of the orbital walls is only of secondary importance to the injury which caused it, and may be left to itself; it is of more interest to the general surgeon than the specialist.

Vascular protrusion of the eyeball.—This is the name applied, and very justly, by Mr. Thomas Nunneley ('Medico-Chir. Trans.,' vol. xlviii) to a set of cases formerly considered to belong to the class of "aneurism by anastomosis," but which Mr. Nunneley shows differ in many essentials from the latter affection, both in their clinical aspect and history. He has also had opportunities of verifying his diagnosis by post-mortem examination, and in no case has he met with an instance of the above-mentioned affection due to this cause. Mr. Nunneley has reported in all seven cases, and mentions some ten or twelve others described by various writers. The cases reported are chiefly either instances of traumatic aneurism or aneurism arising spontaneously from rupture of a diseased artery in an elderly person; but in one case a cancerous growth was found involving the orbit and other parts.

The symptoms complained of by the patient are, noise in the head and feeling of tension, singing in the ears, pain in the orbit and eyeball, all of which are aggravated by stooping or exertion, but are nevertheless most annoying at night. These symptoms are accompanied by more or less protrusion and impaired mobility of the eyeball, dimness of vision, much congestion, principally venous, of the eyelids and conjunctiva, and chemosis; pulsation (which may be controlled by pressure on the carotid of the same side) in any part of the orbit, and communicated to the eyeball, and often a bruit heard on auscultation over the brow or other parts immediately adjoining the orbit.

In most cases these symptoms have come on at a varying time, after some injury to the head, or have occurred spontaneously and suddenly.

The morbid changes met with in the three cases examined after death by Mr. Nunneley were in one (in which the disease commenced spontaneously, and the patient died sixteen days after ligature of the carotid) a dilatation of the carotid at the point of giving off the ophthalmic branch, the dilatation being filled with and surrounded by coagulum; the

A not uncommon cause of pain and irritation is the occurrence of entropion of the lower lids; this must be remedied by operation (*see* Operations on the Eyelids).

CAUSES OF UNSATISFACTORY RESULTS OF CATARACT EXTRACTION.

The result of an operation for extraction of cataract may be marred by closure of the pupil consequent on iritis, by obstruction of its area with opaque lens capsule, or by opacity of the vitreous humor.

Occlusion of the pupil should be remedied by making an artificial one (*see* Artificial Pupil); capsular obstructions should be torn through with cataract needles, cut across with scissors, or removed bodily with forceps.

The greatest caution must always be exercised in meddling with opaque capsule, as an operation upon it, especially an attempt to tear it forcibly away, is very likely to be followed by increase of tension, inflammation, or even suppuration of the eyeball.

For opacity of the vitreous humor nothing can be done.

EXTIRPATION OF THE EYEBALL.

Removal of the eyeball is called for under the following conditions:—

(1) In all cases of injury causing complete disorganization, with collapse of the globe and escape of its contents.

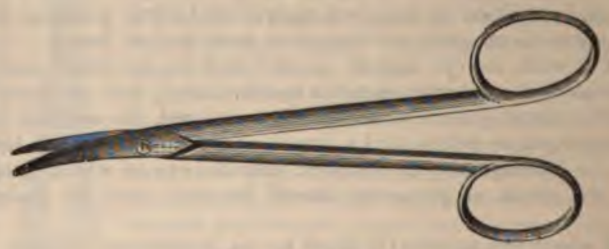
(2) In cases where one eye, having been damaged by injury or disease to such an extent as to render it *practically useless*, becomes irritable or painful, and the sound eye appears threatened by sympathetic ophthalmia.

(3) In cases where an eye lost from injury or disease, and *quite blind*, is a source of annoyance, even though the other eye be not threatened.

(4) In cases where the globe has become the seat of malignant disease.

Extirpation of the eyeball should be thus performed (for position of patient and operator *see* Fig. 94, p. 250): The instruments required are a wire speculum, toothed forceps, a pair of blunt-pointed scissors, curved on the flat (Fig. 106) and a strabismus hook.

FIG. 106.



Extirpation scissors.

The patient being thoroughly under the influence of an anæsthetic, the operator should place the wire speculum between the lids, then by the aid of the forceps and scissors cut through the conjunctiva all round the cornea as close to its margin as possible; he should then, with the strabismus hook, take up the four recti muscles, one after the other, and divide them with the scissors, either the external or internal rectus being cut at a little distance from the globe, so as to afford a hold for the forceps in the subsequent steps of the operation, and the other three muscles as close to it as possible.

The muscles having been divided, the hook should be made to sweep round the globe, so as to be sure that nothing is left uncut. By pressing the speculum backwards the eyeball will become dislocated in front of the lids, and then being steadied by holding the piece of muscle purposely left, with the forceps, the scissors should be passed behind it until their points are found to be in contact with the optic nerve, then slightly withdrawn, opened widely, pressed forwards again, and the nerve divided by a single cut.

As soon as the nerve has been cut through, the eyeball will be almost free, being held only by the oblique muscles, which should be divided close to the sclerotic. Should there be free hemorrhage the speculum may be left between the lids, a piece of sponge pressed firmly into the orbit, and secured by a turn of bandage; when all bleeding has ceased the sponge should be removed with the speculum, and two small pads of wet lint and a band-

EXOPHTHALMIC GOITRE (BASEDOW'S DISEASE).

This disease is characterized by protrusion of the eyeball, impairment of the movements of the lids, and diminished sensibility of the cornea and conjunctiva, accompanied by disturbance of the heart's action and systolic murmurs in the heart and great bloodvessels of the neck together with dyspnœa and enlargement of the thyroid body.

TREATMENT.—Should the protrusion of the eyeballs be very extreme, ulceration and perforation of the cornea may occur; this may be guarded against by protecting the cornea with a small pad and light bandage applied over the closed lids, or the palpebral aperture may be closed by operation. These patients are, however, extremely intolerant of anæsthetics. General medical treatment should also be employed; for this the reader is referred to works on general medicine.

TUMORS OF THE ORBIT, ORBIT AND EYEBALL, AND EYEBALL ALONE.

Tumors of the orbit alone are—exostoses, nævi, cysts, nodes, and malignant growths. Those of both orbit and eyeball are usually malignant, and commence primarily either in the eyeball or some of the other structures within the orbit. Those of the eyeball alone are also for the most part malignant, but simple sarcomatous and cystic growths are occasionally met with.

TUMORS OF THE ORBIT ALONE.

Exostoses.—These are of two kinds, either hard, ivory-like masses, consisting of compact bony tissue; or soft spongy growths, of an open cancellated structure.

Bony tumors are generally met with as hard, more or less circumscribed outgrowths of varying size, growing either from the bone itself or from the periosteum. They affect the orbit alone, or may project into neighboring cavities, a fact which should be borne in mind when attempting their removal.

TREATMENT.—Should exostosis of the orbit give rise to inconvenience, it may be removed by operation. An incision should be made, parallel with the margin of the orbit, over the most prominent part of the growth, which, having been thoroughly exposed, should be removed in any way which may appear the most effectual, the greatest care being taken to guard the eyeball from injury, and, if possible, to preserve the continuity of the lachrymal canaliculi and position of the tear puncta. In the removal of the hard ivory exostosis the greatest difficulty will be experienced, some hours' patient work with chisel and mallet being occasionally required. The surgeon who undertakes the removal of such a growth should be aware of the extreme difficulty to be surmounted, and arm himself with a corresponding amount of patience and perseverance before commencing the operation. The soft, spongy growths are much more easily removed; the tumor, having been thoroughly exposed, can usually be broken off with strong forceps. Should the growth be on the inner side of the orbit, and much force be used in its removal, the cavity of the nose may be opened and the operator may be rather alarmed at seeing large quantities of air blown out with the blood. This accident, however, need occasion no uneasiness, as it makes no difference to the progress of the case; nevertheless, care should always be taken not to fracture the orbital walls; should the fracture take place in the roof, instead of the inner wall, the consequences would be most disastrous, as the cavity of the cranium would be opened.

Nævi are not uncommonly met with in or about the orbit, situated generally near its margin, or in the eyelids, but sometimes growing deeply in the orbital cavity. They present much the same characters as in other situations, being soft to the touch, of a bluish color, and becoming harder and more tense during crying or straining.

TREATMENT.—Subcutaneous ligature is most applicable in some cases, but care should be taken to prevent as much as possible subsequent cicatrization, in consequence of the deformity it may produce in or about the eyelids. Other cases may be treated by setting up adhesive inflammation within the growth, by the use of the galvanic cautery, or by passing a number of small setons soaked in perchloride of iron through its substance. The setons should be left in until they have set up a slight amount of suppuration. Injection of the growth with perchloride of iron, solution of tannin, or chloride of zinc, may also be tried, but the greatest caution is necessary, as the operation has occasionally been followed by the sudden death of the patient.

Cysts.—Various kinds of cysts are met with in and about the orbit, the most common being the congenital dermoid cyst (*see* Operations on the Eyelids). Simple cysts, probably the remains of hemorrhages, and cysts connected with the lachrymal gland, are also met with. Hydatids have occasionally been seen.

Nodes.—Periosteal nodes are not unfrequently met with; they occur as hard and sometimes painful tumors, usually situated somewhere about the margin of the orbit, but sometimes deep in its cavity. The existence of a node deep in the orbit should always be suspected in cases of paralysis of any of the ocular muscles, displacement of the eyeballs, &c., if these symptoms be associated with nodes on the forehead or margin of the orbit and other symptoms of syphilis. Nodes gradually disappear under anti-syphilitic treatment.

SARCOMATOUS OR CANCEROUS GROWTH may be met with, and when possible they should be removed by operation.

Tumors of Orbit and Eyeball.

The tumors affecting the orbit and eyeball are malignant growths which have usually commenced within the eyeball and afterwards perforated the tunics and implicated the tissues of the orbit. They are generally of the variety known as melanotic sarcoma.

The appearance of the tumor varies according to the stage of growth at which it has arrived. In an advanced case a large fungoid mass of a dirty grayish or brownish color, having a foul surface covered in parts with dark scabs, in others discharging thin unhealthy matter occasionally mixed with blood, will be seen protruding between the swollen and distended lids. On closer examination the eyeball (as such) will be found nearly destroyed, portions of the sclerotic alone remaining in their proper position. The movements of the globe are much impaired, or altogether wanting, the growth having implicated the whole of the tissues of the orbit in one malignant mass. It is curious how the growth as it advances beyond the limits of the eyeball loses its melanotic character and becomes light colored.

The constitutional disturbance in these cases is often severe, especially when the disease is far advanced.

TREATMENT.—The treatment of these growths depends much on the extent to which the tissues of the orbit are implicated and the state of the patient's health.

If the tumor is fairly circumscribed, so that there appears to be a reasonable hope of removing the whole, and the patient is in such a state of health as to preclude the likelihood of similar deposits in other parts, extirpation of the eyeball and other diseased tissues should be performed, any portions of growth that may be left being afterwards destroyed by some escharotic. But should the orbit be so filled by cancerous deposit that there appears to be little hope of removing the whole growth, more especially if the patient is in a cachectic condition, no operation should be thought of, and the surgeon must content himself with palliative treatment, as opiates to relieve pain, and attention to the general health.

Tumors of the Eyeball.

(1) **Glioma.**
(2) **Sarcomata,** melanotic, round, and spindle-celled.
(3) **Carcinoma.**
(4) **Strumous** deposit.

Glioma is most commonly met with in children, but occasionally in older persons.

Sarcomata, melanotic, round, or spindle-celled, are usually met with in persons of from fifty to sixty years old, and occasionally in early adult life. The melanotic is the most common form.

Carcinoma has been met with in persons past the middle period of life, but its occurrence is rare.

Glioma commences in the retina; it presents the following appearance: Should the patient be a child, it will generally be healthy looking and present no signs of cachexia; attention has been drawn to the eye from a peculiar glistening appearance of the pupil (cat's eye). On examination the surgeon will notice the peculiar reflection through the pupil, which is generally somewhat dilated but movable in the earlier stages. Examination, both by means of the ophthalmoscope and by lateral illumination, will show a whitish growth projecting into the vitreous chamber, either as a single prominence or in nodules;

the growth will gradually increase, its surface become covered with bloodvessels, the retina be displaced, and sight soon entirely lost.

As the disease progresses the tension of the globe increases, the pupil becomes widely dilated and fixed, the iris pushed forwards and nearly in contact with the cornea, and the lens opaque, preventing a view of the interior of the eye; the whole globe now gradually enlarges, frequent inflammatory attacks occur, the sclerotic becomes thinned, and at last, if the growth is allowed to remain, a slough forms near the centre of the cornea, which ruptures, and a fungoid bleeding mass protrudes.

The increase of the growth now becomes much more rapid, and it may grow to a considerable size in a short time.

As soon as the growth becomes exposed to the air it commences to discharge thin sanious pus and blood, and becomes more or less coated with a dirty yellow scab. The eyelids become inflamed and swollen, sharp attacks of hemorrhage may take place, the general health suffers, and the patient dies from exhaustion or from extension of the disease to the brain.

Glioma in its earlier stages is likely to be confounded with scrofulous deposit within the eyeball, but it is not likely to be thus mistaken after perforation has occurred.

Treatment.—The only treatment of glioma is extirpation of the globe, and this should be done as soon as the nature of the disease has been made out; but however early the operation may be performed, the disease is almost certain to return, either in the optic nerve or brain.

Melanotic sarcoma, or black cancer, affects persons of advanced age; it is a variety of soft cancer, characterized by the development of black pigment-cells; it may grow either from the interior or exterior of the eyeball, but generally commences in the choroid. It is said not to be so liable to recur as glioma. Round- and spindle-celled sarcomata also commence most commonly in the choroid.

Treatment.—Early extirpation. In all cases of excision for malignant growths, the optic nerve must be cut as far back as possible.

Carcinoma, as above stated, is rarely met with.

Strumous deposit.—The appearance of this deposit within the eyeball closely resembles that met with in the early stages of glioma. The patients are usually children. There is a peculiar glistening appearance of the pupil noticed in glioma, and bloodvessels are seen upon the surface of the growth; the retina is more or less displaced by fluid between it and the choroid, and floats in the vitreous chamber. The growth goes on increasing, the pupil becomes dilated, its mobility is destroyed; the lens becomes opaque the sclerotic thinned, the whole eyeball somewhat enlarged, and suppuration may occur supposing the disease to have gone on up to this point, there is nothing by which it can be distinguished from glioma.

Now, however, the difference becomes manifest; the growth, instead of increasing, destroying the cornea, and projecting from the eyeball commences to shrink, and with it the eyeball, which becomes soft, and is at length reduced to a small irregular mass. The growth of strumous deposit may become arrested at any time, and the shrinking of the eyeball commence; in this, again, it differs from glioma.

Treatment.—Should there be much pain, the eyeball must be removed, otherwise tonics and good generous diet will suffice.

Inflammmation and Suppuration of the Eyeball (Ophthalmitis).

Ophthalmitis is usually the result of injuries, especially of those complicated by the lodgment of a foreign body within the globe; it unfortunately not unfrequently follows operations for cataract, and is occasionally met with during erysipelas, pyæmia, scarlet fever, &c., and sometimes in women after confinement, especially if the strength is lowered by over-lactation. The disease may begin in any of the structures of the eyeball. Should it commence in the cornea and iris, the former will become cloudy, and soon abscesses will form in its substance, the iris likewise becoming discolored and covered with pus. The suppuration may stop short here, the cornea and iris being alone destroyed, and the eyeball left with some perception of light (*see* Suppuration of Cornea and Iris). Should the disease, however, commence in the deeper structures of the eyeball, rapid impairment of vision will take place, all perception of light being lost in perhaps a few hours.

If the pupil be clear, pus may be seen behind it, but in most cases all appears dark; the movements of the eyeball are much impaired, and the lids and conjunctiva considerably swollen. As the disease advances the eyeball becomes enlarged and its tension ophthalmic artery itself was somewhat dilated, its coats thickened, and atheromatous in parts; two of its branches were much dilated and filled with clot. In another case, also of spontaneous origin, a circumscribed aneurism of the ophthalmic artery, close to its origin, was discovered. The third case was found to be one of cancerous disease within the orbit, associated with cancerous tumors, in other parts of the body.

In the majority of cases of "vascular protrusion" of the eyeball, the disease is not within the orbit, but intracranial, the protrusion being dependent on obstructions to the return of venous blood, and analogous to the swelling and congestion seen in the limbs when the main artery is affected by aneurism.

It is easy to understand how, in a small and firmly bounded space like the cavernous sinus, a very insignificant dilatation of the commencement of the ophthalmic artery, or of the carotid itself at any point within the sinus, or a small hemorrhage from either, may prove a most serious impediment to the return of venous blood, much more so than the same amount of disease situated in the cavity of the orbit itself.

Nævus, as is well known, is not unfrequently met with in the orbit, but is, usually, easily enough diagnosed. (*See* p. 279.)

A case of traumatic aneurism of the orbit, which is, I believe, unique, came under my observation in September, 1873.

The patient, a young gentleman, was, some two months previously, opening a hamper in which were some bottles of soda water; one of these burst, and a large piece of glass was driven with considerable force into the left orbit, inflicting a wound in the upper eyelid, just external to the internal angular process of the frontal bone; the glass dropped out; sharp arterial hemorrhage occurred, which was stopped by pressure; much swelling and ecchymosis of the lids followed. The wound healed, the swelling and ecchymosis disappeared, and all appeared to be going on well, but shortly before being seen by me the eyeball seemed to be somewhat protruded, and considerable congestion of the eyelids and conjunctiva was noticed. When first seen by me there was much venous congestion of the eyelids and conjunctiva (no chemosis), marked protrusion of the eyeball in a direction somewhat outwards; a small pulsating tumor could be distinctly felt near the inner angle of the orbit; a marked thrill was communicated to the eyeball, which could be felt on placing the hand upon the closed lids; a buzzing in the head was complained of, especially on stooping; there was a small linear cicatrix over the pulsating tumor, marking the seat of the original injury.

Ophthalmoscopic examination showed an extremely dilated and tortuous condition of the retinal veins, but detected no pulsation; there was no impairment of vision.

Pressure on the left carotid at once stopped the pulsation, and caused considerable decrease of the venous congestion.

Aneurismal varix was diagnosed. Perfect rest and pressure applied directly to the part were tried for some months without benefit. It was at length determined by the patient's medical attendant to perform an operation; accordingly, an incision was made over the tumor, and several fair-sized vessels which appeared to communicate with it were tied; the wound healed kindly.

I saw the patient again at the beginning of the summer of 1874. The congestion had disappeared, the pulsation ceased, and the eyeball had returned to its natural position, the only sign of the disease remaining being a small linear cicatrix in the upper eyelid and a slight thickening near the inner angle of the orbit in the position previously occupied by the pulsating tumor.

TREATMENT.—Rest, low diet, with depressing remedies, as cold applied locally, and the administration of digitalis or antimony, should always have a fair trial. Pressure applied locally, by means of a pad and bandage, should also be employed if it can be borne.

These means failing, recourse must be had to digital pressure of the carotid, kept up for some hours, the patient being under the influence of an anæsthetic, as pressure in the neck gives rise to such intolerable pain, that even the most resolute can only bear it for a few minutes at a time.

As a last resource, a ligature must be applied to the common carotid on the same side as the disease.

This operation was performed in all but one of Mr. Nunnelley's cases with the best results.

Should a case similar to that reported in this article occur, the operation which proved so successful in it should be performed.

EXOPHTHALMIC GOITRE (BASEDOW'S DISEASE).

This disease is characterized by protrusion of the eyeball, impairment of the movements of the lids, and diminished sensibility of the cornea and conjunctiva, accompanied by disturbance of the heart's action and systolic murmurs in the heart and great bloodvessels of the neck together with dyspnœa and enlargement of the thyroid body.

TREATMENT.—Should the protrusion of the eyeballs be very extreme, ulceration and perforation of the cornea may occur; this may be guarded against by protecting the cornea with a small pad and light bandage applied over the closed lids, or the palpebral aperture may be closed by operation. These patients are, however, extremely intolerant of anæsthetics. General medical treatment should also be employed; for this the reader is referred to works on general medicine.

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The appearance of the tumor varies according to the stage of growth at which it has arrived. In an advanced case a large fungoid mass of a dirty grayish or brownish color, having a foul surface covered in parts with dark scabs, in others discharging thin unhealthy matter occasionally mixed with blood, will be seen protruding between the swollen and distended lids. On closer examination the eyeball (as such) will be found nearly destroyed, portions of the sclerotic alone remaining in their proper position. The movements of the globe are much impaired, or altogether wanting, the growth having implicated the whole of the tissues of the orbit in one malignant mass. It is curious how the growth as it advances beyond the limits of the eyeball loses its melanotic character and becomes light colored.

The constitutional disturbance in these cases is often severe, especially when the disease is far advanced.

TREATMENT.—The treatment of these growths depends much on the extent to which the tissues of the orbit are implicated and the state of the patient's health.

If the tumor is fairly circumscribed, so that there appears to be a reasonable hope of removing the whole, and the patient is in such a state of health as to preclude the likelihood of similar deposits in other parts, extirpation of the eyeball and other diseased tissues should be performed, any portions of growth that may be left being afterwards destroyed by some escharotic. But should the orbit be so filled by cancerous deposit that there appears to be little hope of removing the whole growth, more especially if the patient is in a cachectic condition, no operation should be thought of, and the surgeon must content himself with palliative treatment, as opiates to relieve pain, and attention to the general health.

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Glioma commences in the retina; it presents the following appearance: Should the patient be a child, it will generally be healthy looking and present no signs of cachexia; attention has been drawn to the eye from a peculiar glistening appearance of the pupil (cat's eye). On examination the surgeon will notice the peculiar reflection through the pupil, which is generally somewhat dilated but movable in the earlier stages. Examination, both by means of the ophthalmoscope and by lateral illumination, will show a whitish growth projecting into the vitreous chamber, either as a single prominence or in nodules;

the growth will gradually increase, its surface become covered with bloodvessels, the retina be displaced, and sight soon entirely lost.

As the disease progresses the tension of the globe increases, the pupil becomes widely dilated and fixed, the iris pushed forwards and nearly in contact with the cornea, and the lens opaque, preventing a view of the interior of the eye; the whole globe now gradually enlarges, frequent inflammatory attacks occur, the sclerotic becomes thinned, and at last, if the growth is allowed to remain, a slough forms near the centre of the cornea, which ruptures, and a fungoid bleeding mass protrudes.

The increase of the growth now becomes much more rapid, and it may grow to a considerable size in a short time.

As soon as the growth becomes exposed to the air it commences to discharge thin sanious pus and blood, and becomes more or less coated with a dirty yellow scab. The eyelids become inflamed and swollen, sharp attacks of hemorrhage may take place, the general health suffers, and the patient dies from exhaustion or from extension of the disease to the brain.

Glioma in its earlier stages is likely to be confounded with scrofulous deposit within the eyeball, but it is not likely to be thus mistaken after perforation has occurred.

TREATMENT.—The only treatment of glioma is extirpation of the globe, and this should be done as soon as the nature of the disease has been made out; but however early the operation may be performed, the disease is almost certain to return, either in the optic nerve or brain.

Melanotic sarcoma, or black cancer, affects persons of advanced age; it is a variety of soft cancer, characterized by the development of black pigment-cells; it may grow either from the interior or exterior of the eyeball, but generally commences in the choroid. It is said not to be so liable to recur as glioma. Round- and spindle-celled sarcomata also commence most commonly in the choroid.

TREATMENT.—Early extirpation. In all cases of excision for malignant growths, the optic nerve must be cut as far back as possible.

Carcinoma, as above stated, is rarely met with.

Strumous deposit.—The appearance of this deposit within the eyeball closely resembles that met with in the early stages of glioma. The patients are usually children. There is a peculiar glistening appearance of the pupil noticed in glioma, and bloodvessels are seen upon the surface of the growth; the retina is more or less displaced by fluid between it and the choroid, and floats in the vitreous chamber. The growth goes on increasing, the pupil becomes dilated, its mobility is destroyed; the lens becomes opaque the sclerotic thinned, the whole eyeball somewhat enlarged, and suppuration may occur supposing the disease to have gone on up to this point, there is nothing by which it can be distinguished from glioma.

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TREATMENT.—Should there be much pain, the eyeball must be removed, otherwise tonics and good generous diet will suffice.

INFLAMMMATION AND SUPPURATION OF THE EYEBALL (OPHTHALMITIS).

Ophthalmitis is usually the result of injuries, especially of those complicated by the lodgment of a foreign body within the globe; it unfortunately not unfrequently follows operations for cataract, and is occasionally met with during erysipelas, pyæmia, scarlet fever, &c., and sometimes in women after confinement, especially if the strength is lowered by over-lactation. The disease may begin in any of the structures of the eyeball. Should it commence in the cornea and iris, the former will become cloudy, and soon abscesses will form in its substance, the iris likewise becoming discolored and covered with pus. The suppuration may stop short here, the cornea and iris being alone destroyed, and the eyeball left with some perception of light (*see* Suppuration of Cornea and Iris). Should the disease, however, commence in the deeper structures of the eyeball, rapid impairment of vision will take place, all perception of light being lost in perhaps a few hours.

If the pupil be clear, pus may be seen behind it, but in most cases all appears dark; the movements of the eyeball are much impaired, and the lids and conjunctiva considerably swollen. As the disease advances the eyeball becomes enlarged and its tension increased, and if left to itself will rupture and discharge its contents much to the patient's relief. The globe afterwards shrinks to a small button-like stump. Pain is very severe in many cases, but occasionally is altogether wanting. Suppuration of the eyeball rarely sets up sympathetic changes in the fellow eye.

Treatment.—This depends upon the cause of the disease, and whether one or both eyes are affected. Should the inflammation depend upon the lodgment of a foreign body, this should be removed without any reference to its position or the state of vision; if the eye have still good perception of light it will certainly be destroyed, and whatever difficulties the surgeon may encounter he cannot possibly make matters worse, and he should not hesitate an instant, or he will lose his chance of preserving any sight that may be left. Any foreign body having been removed, the surgeon's next care should be to relieve pain, and, if possible, check the progress of the inflammation.

These indications are best carried out by the application of leeches (if the patient be strong, and can bear bloodletting), by opium internally, and by the constant use of sedative fomentations; the best being the Fotus Belladonnæ (made by dissolving a drachm of extract of belladonna in a pint of warm water) mixed with an equal quantity of Fotus Papaveris (made by boiling an ounce of poppy-heads in a pint of water); a piece of rag or lint soaked in this mixture as hot as it can be borne should be kept constantly applied to the affected eye. Poultices may also be employed. Most patients will require the administration of a fair amount of stimulant, good food, with iron and quinine.

When suppuration has been fairly established, and all perception of light lost, the eyeball must be treated as an ordinary abscess and the pus let out by incision.

CHAPTER IX.

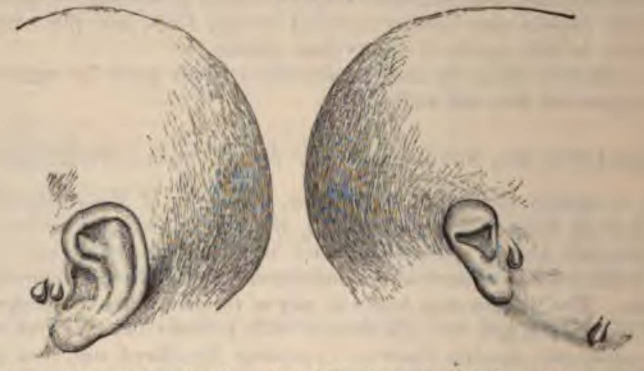
AFFECTIONS OF THE EAR.

By Mr. Laidlaw Purves.

AFFECTIONS OF THE EXTERNAL EAR.

Malformations.—The malformations of the external ear which are met with are very varied, extending from cases in which there occur an entire want of the auricle to those in which the possession of a double set is seen. In cases where the hearing is not affected by the malformation the surgeon may be consulted as to the propriety of an operation with a cosmetic view. He must in these regulate his opinion by the usual surgical rules, having regard to any possible interference with the acuteness of hearing which an operation might entail. The most common malformation is a congenital, either partial or entire, want of the auricle, with a failure of the meatus auditorius externus, or an occluded

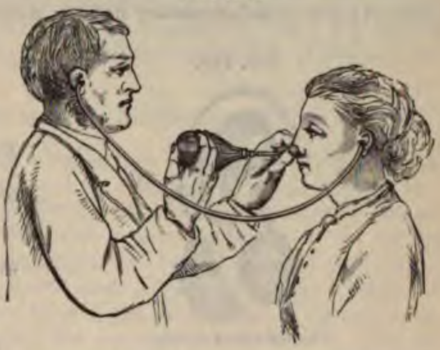
Fig. 107.



Drawing of occluded ears taken from a female patient of Mr. Bryant's, aged three months. Right auricle smaller than left and more deformed. The pendulous bodies contained cartilage, the child had likewise a pendulous outgrowth on left nostril.

meatus, the lobules of the ear occasionally being displaced either on to the neck or cheeks (*vide* Fig. 107). But the auricle may be absent from injuries, and the meatus closed from otitis, lupus, &c. Such defects do not necessarily occasion an absence of the hearing power, and cases are on record in which patients with this defect could hear sufficiently well to hold conversations with those to whose voices they were accustomed. Before deciding to operate in such congenital cases it is advisable to keep the child under observation for some time for the purpose of noting if any signs of hearing are developed. Should it be determined to operate, the point of operation may now and again be fixed by passing a current of air through the Eustachian tube and noting the point at which the impingement of air at the end of the cul-de-sac is heard best. This is accomplished by using what is generally called "Politzer's method" (Fig. 108), which consists in passing the soft nozzle of a caoutchouc bag filled with air into one or other nostril of the patient, and while he swallows a mouthful of water, compressing the nostrils with the fingers of the left hand so as to prevent the exit of air through them. At the same moment the right hand forcibly expels the air from the bag in such a way that, finding no passage open except the Eustachian tubes, it rushes up them, passes into the tympanic cavity, and pushes out the membrana tympani. It is this sudden rush of air against the external wall of the cavity which the surgeon listens for by means of a tube of India-rubber, passing from the meatus of the patient to that of the surgeon. In cases of absence of the meatus a stethoscope may be used, by which the surgeon determines at which point the air impinges most forcibly, and at this point he makes his opening. If hard and bony at this spot, the trephine will be necessary, if soft, the knife will suffice, making a crucial opening and keeping the opening patent by means of tents or other foreign bodies. In congenital cases the opening ought to be made very carefully, watching for the membrana tympani; but should there be no membrane found on cutting down to the usual position of such it is advisable to allow the artificial opening to close again. If the deafness before operating is very great it is probably better to discountenance any operation, as the results of interference with congenital malformations of the ear have generally been by no means satisfactory.

Fig. 108.



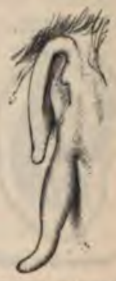
Politzer's method of inflating the middle ear.

Cutaneous affections of the external ear.—Hypertrophy from chronic inflammation, eczema (acute and chronic), herpes, impetigo, pemphigus, erysipelas, affect the auricle, and have much the same appearances, follow the same courses, and are amenable to the same treatment as in other parts of the body. Particular attention ought to be paid to any skin affections which may be present in the neighborhood of the auricle, especially in the hair, careful note being paid to the sort of pomade or other application the patient uses for cosmetic purposes. The meatus auditorius externus ought to be cleared once daily by a lukewarm water injection of any collection of epidermis or cerumen which is apt to be of a greater quantity than normal during the progress of the skin affection.

Injuries to the External Ear.

Injuries to the external ear are by no means rare, but, happily, if confined to the auricle, they affect the hearing of the sufferer but slightly. Under the usual treatment they generally do well, care being had to make as perfect an adjustment of the parts as possible. In 1866 Mr. Bryant treated a girl of twelve years of age for the effects of an ulceration of the external ear some years previously. The condition of the ear is indicated in the accompanying engraving (Fig. 109). By paring the edges of the pendulous portions of the auricle, and the skin covering over the parts behind, a good-looking entire ear was made with great addition to her comfort.

Fig. 109.



Drawing 224^{80}½

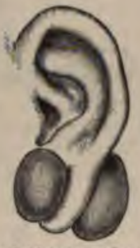
The tumors of which the auricle may be the seat are the othæmatomatous, gouty, fibro-plastic, fibro-cartilaginous, sebaceous, erectile, epitheliomatous, and sarcomatous.

The fibro-plastic or cheloid has been already alluded to as occurring in the lobulus of the ear after the operation of puncture. I have seen many such, the largest having been the size of a walnut (Fig. 110). They generally do well after excision, but if not thoroughly removed will grow again. The othæmatomatous requires special mention, but the others are to be recognized and treated as in other parts of the body.

Report by Dr. Goodhart on Cheloid Tumors of the Ear.

The small tumors or thickenings of the skin which usually go by the name of cheloid (Alibert) are of inflammatory nature, with more or less tendency to become fibrous.

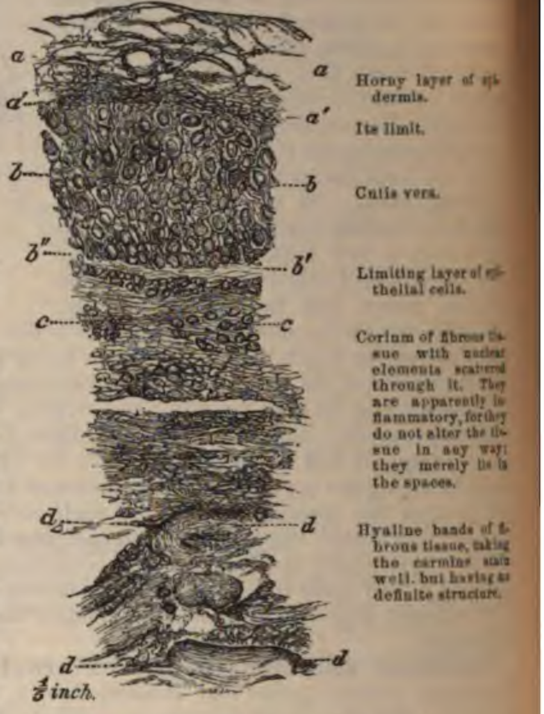
Fig. 110.



Cheloid tumor of ear.

Fig. 111 gives the microscopical appearances of one of those cheloid tumors from the pencil of Dr. Goodhart.

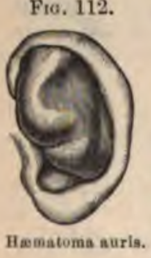
Fig. 111.


a
a
a′
a′
b
b
b″
b′
c
c
d
d
d
d
$\frac{1}{8}$ inch.
Horny layer of epidermis.
Its limit.
Cutis vera.
Limiting layer of epithelial cells.
Corium of fibrous tissue with nuclear elements scattered through it. They are apparently inflammatory, for they do not alter the tissue in any way; they merely lie in the spaces.
Hyaline bands of fibrous tissue, taking the carmine stain well, but having no definite structure.

These drawings, made from a section of one of these growths in the lobule of an ear which had been pierced for an earring, show the microscopical characteristics. Its macroscopical appearance was that of a fibrous tumor. It will be seen that, in addition to newly formed fibrous tissue, there is also a great deal of nuclear germination going on.

Idiopathic hæmatoma auris, or vascular tumor of the ear, consists, according to the latest trustworthy authorities, of a degenerative morbid process induced by general disturbances of nutrition. The cartilage of the auricle is its seat, but the pathological appearances differ, as some have found the perichondrium separated from the cartilage, while others have found "pieces of the cartilage attached to the perichondrium." In other cases the cartilage has been found thicker but no harder than natural, the thickened part presenting no appearance of a cyst, but under the microscope showing hypertrophied cartilage-cells and intercellular matter. This idiopathic hæmatoma commences by a flushing of the auricle, which becomes hot and painful. In a few hours an effusion of blood takes place, which, generally commencing in the concha, gradually spreads over the auricle, feeling firm to the touch, but allowing of fluctuation being detected if looked for with care. It is believed to be peculiar to patients suffering from different forms of insanity, general paralysis having the largest share, melancholia, acute and chronic mania and dementia, following in the order named. Dr. Hun thinks that the affection obtains such an exclusive position amongst the insane that he holds that any one suffering from hæmatoma auris, although sane at the time of observation, ought to be suspected of insanity.

Fig. 112.



Hæmatoma auris.

That the affection occurs in persons who have no hereditary history and show no symptoms of insanity is undoubted, but whether the pathological changes at the seat of the tumor are the same in those cases or differ in the other cases in which there is a history of traumatic injury is yet undetermined, though I am inclined to believe from the cases which have come under my own notice that those resulting from injury do not arise from the same pathological changes.

The modes of treatment recommended by different authorities vary. Gruber recommends evacuation of the fluid and coagula and the after-use of a compress bandage, while Wendt relates a case where vascular tumor recurred twice after incision, but passed off under lead-water applications and compression. I have tried the different methods proposed, once passing a seton through the tumor, and keeping up a slight discharge from it, and find them get well under all the different methods. Since the application of astringent lotions and a compress is less alarming to the patient, and seems as effectual, I am inclined to follow it in future cases, keeping up the compression by a modified letter clip applied to the ear, padding the arms of the clip so as to prevent injury to the skin of the auricle.

Affections of the External Meatus.

To examine the external meatus it is usually necessary to employ a speculum for the purpose of straightening and widening the canal, and so allowing of the passage of rays from a natural or artificial light. The specula are formed of silver or caoutchouc and are of various forms. The silver speculum of Wilde, with a round aperture at the narrow end, will be found as convenient as any, it being necessary to have three or four different sizes. If available, sunlight, either direct or reflected from a white cloud, is, I think, the best mode of illumination, as it gives the different tints of the meatus and tympanic membrane more truly than any artificial light. Seating the patient near a window, with the ear to be examined away from the window, you receive the rays on a mirror either held in the hand or placed on the forehead, and reflect them into the meatus by inclining the mirror to the required angle. If you use the rays direct from the sun itself it is necessary that a plane mirror should be used, the usual concave mirror soon causing such an amount of heat to be felt at the spot on which the reflected rays are thrown that the patient cannot endure a long examination. Should sufficient daylight not be obtainable, an argand burner, with or without a bull's-eye lantern placed over it, will act as a good substitute. Having arranged your flood of light so that it falls on the auricle and external meatus, you take the superior and posterior part of the auricle between the middle and index fingers of the left hand, and, pulling the auricle backwards and upwards, you widen more fully the lumen of the meatus, into which you introduce by the right hand the small round end of the speculum. Passing it gently in by a slightly rotating motion, you reach a spot where, there being no foreign body to occlude the view, if the meatus is of a normal width the tympanic membrane will be exposed to view. On accomplishing this, the external edge of the speculum is passed to the care of the thumb and index fingers of the left hand, which move it in different directions so as to throw rays on the different portions of the canal and the tympanic membrane, while the right hand is left free to use the mirror, or, placing the mirror on the forehead, to use any instruments which may be necessary.

The most frequent change in the external meatus which comes before the surgeon on thus looking into the canal is an accumulation of cerumen, known by its position, form, color, and light reflection. It occurs on account of some hyperæmia of the ear, of which a very common cause is the irritation arising from scratching the meatus with pencils, pins, &c.; but anything which causes an increased flow of blood to the lining membrane of the meatus will cause a greater accumulation of cerumen than normal. It also occurs in those much exposed to the sun and dust, in those who perspire freely, and in the old, in whom the cerumen is denser and stiffer than in the young.

The subjective symptoms caused by such accumulations are pain, vertigo, confusion of ideas, tinnitus aurium, and deafness, the latter symptom being often characterized by its sudden entrance and departure.

The prognosis is not so favorable as is generally supposed. If a vibrating tuning-fork placed on one of the incisors or on the middle line of the vertex is not heard better, or so well, in the affected ear as in the non-affected, you may expect some complication, and the mere removal of the cerumen will not probably be followed by much beneficial result to the deafness. Toynbee gives, as the results of his removal of accumulations of cerumen from the meatus causing deafness, a table of 165 cases, of which 60 were cured, 43 were improved, and the remaining 62 were "either but slightly or not at all improved." Mr. Hinton gives one in six as his proportions of recovery in the same. It will be thus seen that in a large proportion of cases of accumulation of cerumen in the external auditory meatus there is a complication present which does not give way on the removal of the cerumen, and which clouds the prognosis considerably.

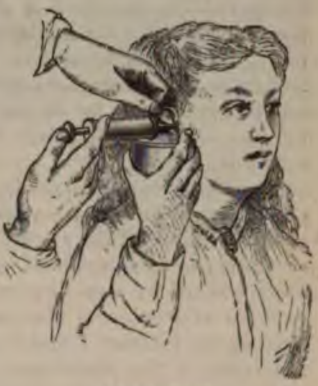
If you can easily lay hold of the accumulation by means of the forceps without risk of pushing it against the membrane, and without causing pain, it is well to remove it in this way, especially if you are removing it for the purpose of obtaining a view of the parts behind which you wish to examine on account of some affection present, as, should there be some abnormality of the parts behind, the passage of a strong current of water might prejudice them. But should it not be practicable to remove the accumulation by the forceps without causing irritation, the syringe must be used in the manner described in treating of foreign bodies in the meatus.

A lessening of the secretion is sometimes seen in acute affections of the middle ear, and in nervous deafness, but, before making your diagnosis in such, inquiry of the patient as to what he has done to the ear before coming to you is useful in eliciting a good reason for the condition found. The use of some slight emollient and attention to the primary cause, if any such is detected, comprises the treatment.

FOREIGN BODIES.

In no department of surgery is the aphorism that "blind zeal only hurts" more necessary to be remembered than in that relating to foreign bodies in the ear. The form of the canal is so peculiar, being that of a spiral turning anteriorly inwards and downwards, and having expansions at either extremity, and the forms of the foreign bodies which enter or are placed in the meatus are so varied, that the efforts to remove them by any other means than a current of water must be used only where the practitioner is guided by an accurate knowledge of the anatomy of the external meatus, if damage to the delicate structures which limit the inner end of the meatus is to be avoided. So common are forcible attempts to extract by those unaccustomed to meet such cases, that it is exceptional that a case is seen by the surgeon before such efforts have been made as have caused a certain amount of inflammation of the canal and its consequent lessening in calibre. In such, where the calibre has been rendered too narrow to admit of the passage of the foreign body without considerable force, the first indication is to allay the inflammation by rest, leeches, and fomentations. The exudation having been absorbed, and the canal having nearly or wholly resumed its normal size, the surgeon ought to determine whether there is a foreign body present, and, if possible, its size, form, and position, for cases continually occur in which a patient suffering from chronic disease of the middle ear has the feeling of a foreign body being present, while others are either the subject of delusion from other causes, or are attempting to delude you. This information is obtained by means of the usual mirror, speculum, and probe, by the last of which you can determine if the body is hard or soft or moves easily. If the last is the case you may, by inclining the head to the side of the ear affected, shake it out, or by laying the one hand on the ear a sharp percussion on the hand so placed may remove it. But the persevering use of an injection of lukewarm water from a four- or five-ounce syringe, the point of the nozzle of which has a calibre of from one to two millimetres, is the method which ought to be used above all others, which carries with it the least danger, and is by far the most successful. A bowl being held by the patient so that the rim is pressed against the skin close under the lobule of the ear, the surgeon draws the auricle upwards and backwards so as to straighten the external meatus, and the nozzle being passed slightly within the external opening and pressed against the upper wall, a moderately forcible current is made to pass along the upper wall, sweep across the membrana tympani, and by it is directed outwards, in which latter course it meets with the foreign body, and, carrying it with it, forces it along the lower wall of the canal and out at the external opening. It may be necessary to change the position of the patient's head so as to give the stream a different direction, according to the position of the foreign body in the canal, the endeavor being always to pass the inward current beyond the body, which ought to be influenced only by the outward rush. Should the body be impacted it may be necessary to loosen it by the probe before you can remove it by the syringe, but the first injections generally suffice to do this. This failing, which is extremely rare, and the body being soft, you may pass a hook into it from the side and so extract it; or should it be too large for this you may, having fixed it with the hook so as to prevent it passing further in by your manipulations, pull pieces out of it by means of small kneed forceps and so reduce its bulk sufficiently to extract by the hook. When the body is hard and so formed that the current cannot have much influence upon it, and a hold by forceps or hook cannot be obtained, Lowenberg's method of bringing the point of a camel's-hair pencil armed with joiners' glue or other glutinous material into contact with the body, allowing the viscous substance to harden and thus binding the pencil and the foreign body together and so extracting them, is sometimes useful. Many other instruments have been proposed to remove foreign bodies, most of which are not worthy of a place in the surgeon's armamentarium, but mention must be made of Wilde's wire snare, which may be found very useful and has the advantage of being very safe, and Mr. Durham's ear forceps, which allows of the passage of the instrument through a narrow speculum —a very great desideratum.

FIG. 113.



Syringing ear.

It may happen that none of the above-mentioned means will enable you to extract the body, and yet the symptoms of pressure on the nervous structures—giddiness, confusion, delirium, &c.—are so urgent that removal is imperative. In such you may be compelled to place the patient under chloroform, enter the meatus by loosening the auricle from its superior attachments, or through the mastoid process, and so reach the offending body and extract. But resort to such serious measures will only be called for by the most pressing symptoms, and then probably in cases where violent unsuccessful efforts to extract have been made, *as the mere presence of a foreign body in the external meatus rarely causes much pain or annoyance.*

Before attempting to remove certain bodies it is necessary to place them in a condition favorable to their removal or to allay the unbearable irritation caused by some of them. For example, a ball of cerumen may be so hard that no instrument will pierce it sufficiently to give the surgeon sufficient purchase upon it to extract it, or it may be too large to pass the isthmus of the external meatus without the use of undue force. In such you are compelled to soften it by repeated soakings in hot water or a solution of glycerine, or some alkaline solution, before endeavoring to break it up. Again, when some small animal has passed into the ear and its movements are causing great annoyance by irritating the excessively sensitive tympanic membrane, it is necessary to introduce tobacco smoke or water, or a little spirit and water, or oil, to kill it, and at once allay the irritation before attempts at removal are undertaken.

Maggots are sometimes found in the external meatus and tympanic cavity, especially in cases of otorrhœa, and are generally difficult to remove. Should the membrane not be perforated the syringe will suffice, but, as in the cases in which they are mostly found the membrane is perforated, the forceps is found more effectual. To allay the pain generally occasioned by their presence the injection of ten drops three or four times daily of a lukewarm solution of a grain of acetate of lead and a grain of acetate of morphia in an ounce of water, will be found of service. Various kinds of aspergilli are met with, especially in climates warmer than that of England; but even in England they are more common than is generally believed, judging from the cases reported in the medical journals as rarities and worthy of notice. The appearance on examining the meatus with the speculum is as if fine meal had been blown into the ear, or as if "coal dust had been blown on to white sand." The true diagnosis can be made certain by the microscope only. The parasiticides proposed are many, but warm water often used or a mixture of spirit and water will suffice in all cases.

Should it be found after the removal of any foreign body that the tympanic membrane has changed its position, and does not of itself recover its normal situation, the air-bag or catheter or the vacuum speculum may be of benefit in assisting you to replace it.

A piece of wadding should be lightly inserted in the meatus after the removal of the foreign body, and kept there for some hours, so as to protect the irritated parts from cold, strong noises, &c.

It ought to be remembered that foreign bodies in the ear may cause many reflex actions, such as tickling in the throat, giddiness, pain and heaviness in the head, vomiting, cough and expectoration, sneezing, anæsthesia of side, epilepsy, &c.

Furuncles of the external meatus originate generally in one of the hair-follicles or in one of the ceruminous glands. They occur mostly as the symptom of some constitutional affection, in which case they are associated with boils on other parts, or of some deeper local chronic inflammatory lesion, and are considered in such as a favorable sign. The long-continued use of astringent lotions, especially of alum solution, seems to place the meatus in a condition favorable to their formation, if it be not the actual cause in some cases. The symptoms they occasion are great throbbing and pain, consequent on the unyielding condition of the skin and connective tissue of the external meatus to the pressure from the accumulating pus, fever (especially during the evening), sometimes tinnitus, a feeling of tension in the ear, and more or less deafness, according to the position and extent of the inflammation. They occur at all ages and in all constitutions, but middle age obtains by far the majority of cases. The prognosis is favorable, though you may be unable to check the formation of new crops, which go on for months, even in the most robust people.

The treatment is conducted either with a view to arrest the development of the abscess, or the formation being complete to give the pus free exit. The former may be brought about by painting the swelling with a strong solution of nitrate of silver (ʒss—ʒj to ℥j of water) or a solution of sulphate of zinc of the same strength. The latter is best accomplished by a small narrow knife, so narrow in the blade and handle that it does not exclude your view of the part while making a free incision through the boil. After making the incision I find it useful to apply a vacuum speculum (Siègle's—*see* article on Affections of the Membrana Tympani) to the meatus, and by suction empty the abscess as much as possible of pus and at the same time obtain a free flow of blood from the wound. The application of moist heat afterwards by frequently filling the ear with warm water, and laying for half an hour or so a cataplasm over the whole ear so filled, of leeches in front of the tragus if there is much pain, or of a plug of cotton which has been saturated with glycerine (Fisher), changed twice daily, for the same purpose, and the judicious use of purgatives, result in a favorable termination to the particular boil in question, but the constitutional treatment must follow to prevent, if possible, the development of others. As a local preventive, Mr. Hinton considered that the application to the meatus of red or white precipitate ointment was of service.

Narrowing of the meatus in the cartilaginous portion occurs not unfrequently in the aged, on account of the tense tissue-bundles of the posterior and upper walls having become loosened and sunk forwards against the anterior wall. This narrowing seldom leads to complete closure, and therefore does not influence the hearing power to any extent, but its presence prevents the normal exit of the cerumen, and so tends to the formation of cerumen balls beyond the narrowed part of the meatus and their results. Other narrowings, besides those which are congenital, arise from thickening of the skin after frequent attacks of inflammation of the meatus, after furuncle and other tumors, eczema, and the long use of astringent lotions or ointments. Except in the case of tumors, you may widen the canal by the use of the *Laminaria digitata* or sponge dilators sufficiently to form your diagnosis and apply remedies.

Treat any affection of the tympanic cavity which may be present. Keep the canal clear of cerumen and epidermis by injections of lukewarm water or the passage of a dry camel's-hair pencil, and by the use of small ivory bougies, gradually increased in size so that the amount of pressure may be kept up, promote absorption.

Exostoses of the meatus are found in individuals of the gouty, rheumatic, and syphilitic diatheses, though their connection with this last diathesis is not well established. They are certainly frequent in the meatus of good livers, who are likely to have their mucous membranes frequently congested. On looking into the meatus an elevation is seen, generally about the middle third, the skin over which is reddened and moist, and pressure on which by the sound causes pain.

The treatment is not satisfactory, unless the exostosis has a pedicle, in which case it may be broken off. In other cases, having paid attention to any affection causing congestion of the mucous membrane of the tympanic cavity, the application of iodine to the growth itself, and behind the ear, so as to keep up a slight counter-irritation for a lengthened time, and the exhibition of it internally, offer the best hopes of resolution. Should, however, the exostosis prevent the exit of pus from the parts internal to it, the formation of a channel by a hammer and chisel, trephine, dentists' drill, or electrolysis, and the maintaining of it by tents, may be imperative for the purpose of keeping the parts clean and the application of medicaments to the parts beyond.

Hyperostosis of the bony meatus is seen after a chronic otorrhœa and generally extends through the whole of the bony canal. It is caused by inflammation of the periosteum, which results in a well-developed bony formation. The skin along the narrowed portion of the canal is more or less congested. The treatment is that of exostosis.

uscous tumors of the meatus consist of accumulated laminæ of epidermis and
s matter, enveloped in a thick membrane. Though thus composed of compara-
nocuous material, they have the power of causing absorption of the bone lying in
vith it, passing through it by a clean cut aperture without affecting the bony sides
nal thus caused, and so pursuing their course pass to and press on the parts
causing symptoms varying according to the parts implicated. The diagnosis of
luscous tumor from exostosis is made by pressing a probe on the skin over the
nd noting the hardness of the enlargement. Laying open the tumor, washing out
nulated epidermis by the syringe, and withdrawing by the forceps the lining mem-
the treatment recommended.

ilitic affections of the meatus occur as fissures and ulcerations near the
ondylomata, and exostoses. The ulcerations exhibit the usual punched-out irregu-
ur and discharging surface. The treatment is the usual—general and local.

mmation of the external auditory meatus, or ostitis externa, is
nmatory affection of the cutaneous tissues of that canal, involving more or less,
g to the violence of the attack, the periosteum of the osseous part of the canal and
brana tympani. The patient complains of a continual itching sensation, with a
f heat and dryness in the canal, which compel him to pass any suitable instrument
ay be at hand into the meatus for the purpose of scratching the part implicated.
tation may pass off without forcing the patient to seek advice, or it may pass on
pain shooting over all the affected side of the head, increased by every motion of
l, or by mastication, and accompanied by a feeling of fulness in the ear, by fever
ness. After this congested state has lasted for two or three days that of exuda-
rs, at first as a bright watery discharge, which gradually assumes a mucous char-
d this in its turn gives way to a yellow purulent appearance. The pain, which
has been usually severe, subsides when the purulent discharge shows itself, or soon
ds, and the patient feels lighter and freer of the sensation of "numbness" or
" of which he before complained. A favorable termination without any treatment
v take place, though more frequently the affection becomes chronic, and the
uffers from recurrent attacks on being affected by any exciting cause.

amining the ear it is not always easy to arrive at a satisfactory diagnosis on account
inful swelling of the canal, which is particularly sensitive about the middle third,
nts the introduction of a speculum. When you are able to introduce the speculum
ly well to see the inner part of the meatus you may find a mass of moist or mace-
ite epidermal lamellæ obstructing your view of the membrane, necessitating the
se of the forceps or injection of warm water for their removal. Having removed
l obtained a view of the membrana tympani, you find in those cases in which that
e is affected (and it is rare that you are consulted before it is so), the vessels of
brane increased in number and size and fully injected, or, if the case has reached
stage, the single vessels are no longer visible, and the whole has a resemblance
blennorrhœic conjunctiva. The natural angle formed by the skin of the external
nd its continuation with the dermoid layer of the membrana tympani is oblite-
nearly so, by the pressure of the exudation inside the cutaneous tissues. But the
n may be so great and may have so narrowed the canal of the meatus that only a
t of the membrane can be seen, its appearance depending upon the part seen and
of the affection. The acute stage being neglected, it passes gradually into the
orm, in which there is generally little swelling of the meatus, possibly here and
htly macerated or pus-covered spots which bleed easily on being acted on by the
, or brown, badly-smelling crusts standing upon half-dried secretions. The
f secretions vary from a moisture discernible at the external opening of the
three or four ounces daily of a high-smelling yellow discharge, and changes by
ns and other influences. The alarming results of the affection are dependent
continuance of this otorrhœa, which, if of long standing, may cause opacity or
g of the membrane, polypi, maceration of the surrounding tissues, with ulceration
embrane and its consequences, inflammatory and purulent processes in the dura
d its sinuses. These latter are especially frequent in children in whom the con-
r the transmission of such processes are easy.

agnosis of this diffuse inflammation of the meatus from that of furuncle of the
made by means of a speculum in which a small mirror placed at the end of the
at may be revolved so as to give the observer a reflected image of the different
he meatus in succession, or by means of Blake's small mirrors; or should neither
be admissible by the contraction of the meatus, by the moist appearance of the

dermoid covering of the membrana tympani in furuncle, the same layer in otitis externa having the appearance of the rest of the meatus.

The causes of inflammation are the passing of any acute or chronic exanthemata to the meatus, irritation or injuries to the ear, as by the application of heat or spirits to the meatus, the prolonged use of injections, the pressure of foreign bodies, the passage of cold currents of air or water, the non-drying of the ear and hair around it thoroughly after washing, the presence of fungi, and, in short, anything causing a congestion and irritation of the lining membranes of the meatus.

The affection may run its course in ten or fourteen days if the purulent stage has not been reached, but that stage having supervened it lasts from five to eight weeks generally.

The prognosis in a usual primary case under treatment is favorable, but relapses are common. The form following an acute exanthem is very different, as should the middle-ear inflammatory process be well developed, and the membrane much affected, the chances of saving an entire membrane are lessened.

The treatment is etiological. If there are foreign bodies present their removal demands your first attention, and after this the prevention of any purulent accumulation and the use of frequent injections of warm water are the chief treatment. Should the swelling be great, scarification of the meatus, or an incision and abstraction of blood by the vacuum speculum, seems to be of more use than any other means in causing a speedy subsidence of the thickened membranes, which you may also assist by keeping up a pressure on the circumference of the canal by charpie gently pressed into the meatus, being careful that the charpie is frequently renewed and the meatus cleared of discharge. What is called Wilde's incision, from its having been first brought into notice by Sir William Wilde, is a favorite means of remedy with some, and in the relief of pain, or as a means of giving exit to any exudation which may have passed towards the mastoid process, is very useful. It consists in making an incision down to the bone over the mastoid process, at a distance of from half to three-quarters of an inch from the auricle, carefully avoiding, if possible, severing the posterior auricular artery. The application of leeches in front of the tragus (should the patient be too timid to allow of the abstraction of blood by incision or scarification) is advisable where the pain is severe. During the painful stage no strong astringent lotions must be used, those of a sedative nature being preferred, as morphia, in the strength of gr. j to aq. dest. ℥ss, or sulphate of atropine gr. ij to ℥j. This stage being passed, the use of the customary astringent lotions—alum, sulphate of copper, sulphate of zinc, in solutions of from one to four grains to the ounce, or nitrate of silver of from ten to twenty grains to the ounce—are, with attention to any complication of the middle-ear apparatus and to the diathesis present, sufficient to insure a favorable course. Should the affection have assumed the chronic form, stronger solutions of the astringents mentioned ought to be employed; and the keeping up of a counter-irritation behind the mastoid by tincture of iodine, cantharides ointment, or other irritant, will be found serviceable.

POLYPUS.

Aural polypi generally show themselves during a chronic purulent discharge from the tympanic cavity or external meatus, and are not only caused by such a discharge, but are themselves a means of increasing it by furnishing an additional secreting surface, and, by preventing the exit of discharge, keeping the parts pressed upon by the pus in an unhealthy irritable condition. They are of different forms and appearances, being of a lively red, rich in blood, soft and easily bled by touching, or firm and solid with a glancing surface, grape-like or ragged, so small that their presence can only be determined by a careful inspection of the deeper parts, or so large that they protrude from the meatus. Their positions are as varied as their forms, as they arise from any part of the meatus or tympanic cavity or membrane, the different authorities not being agreed as to which are the most frequent sites. Happily their diagnosis and treatment are the same, the former being their capability of displacement by the sound, and the latter their removal either by caustics, astringents, the forceps, scissors, knife, hooks, the galvanic cautery, or Wilde's snare. If the polypus is sensitive, which is not usually the case, and the patient will not suffer the removal by instruments, the application of undiluted liquor plumbi, or alum, or tannin powder, regularly for a time, care being taken that each new application meets with a clean surface, will suffice; but the treatment above all others is the immediate removal by instruments as far as possible, and the application thereafter to the root of some caustic, such as acetic, nitric, or chromic acid, by means of a glass rod or a piece of wood. The instruments employed for the purpose are numerous, those which I find most useful being Wilde's snare, Durham's forceps, and Hinton's forceps. Wilde's snare is especially valuable, as by its means you are capable of reducing a polypus to a considerable extent without endangering any of the structures near it, while the others have the advantage of easier adaptation to an excresence which is difficult of reaching. Should the polypus be very small, or so situated that you cannot use a cutting or tearing instrument, the application of a thin layer of nitrate of silver, obtained by heating a crystal of the caustic over the flame of a spirit lamp and placing a probe or piece of stout silver wire against the heated crystal, will be found useful in cauterizing it, and at the same time limiting the application to the desired spot, which is not so easy when solutions are employed. After the removal of the polypus the disease, of which the growth was only a symptom, must be attended to.

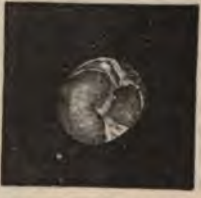
AFFECTIONS OF THE MIDDLE EAR.

Injuries to the membrana tympani.—Rupture of a healthy tympanic membrane is usually caused by the introduction of some sharp instrument through the external meatus, the efforts to extract some foreign body from that canal, or by a sudden concussion over the auricle, as by a blow from the hand, the unexpected explosion of artillery, or such like. The diagnosis of rupture in such is easily ascertained, but medico-legal questions sometimes arise in which it is necessary to determine whether a rupture was caused by a blow on the ear or was present before the blow was given, or whether the membrane was in such an unhealthy condition that it would be easily injured. The rupture of a healthy membrane caused by a blow is usually a long gaping tear,—the gaping depending on the action of the radiating fibres of the middle layer,—the edges of which have a coating of blood upon them. The rest of the membrane is healthy, free of thickening, opacities, cretaceous or other deposits, though possibly hyperæmic. On passing a current of air through the Eustachian you hear a continuous broad soft sound, unlike the broken hiss from the perforation of a diseased membrane, unless some time has elapsed since the rupture was made, in which case infiltration and exudation may have occurred, giving the appearances and sounds of a diseased membrane. The prognosis, unless pus has formed to some extent, and deafness to a considerable extent is present, is very favorable, and the perforation will be quickly healed without further treatment than keeping the membrane protected from cold. Should, however, considerable deafness and tinnitus have occurred from a blow, either with or without rupture of the membrane, the prognosis is unfavorable, as probably the stapes has been driven into the labyrinth, tearing the nerve-fibres and possibly remaining fixed there, and you must keep the patient a lengthened time under observation before giving any opinion of what the results will be.

Inflammation of the membrana tympani, or myringitis, is probably always associated with some affection of the internal or external parts contiguous to it. The diagnosis and treatment will be found in the description of inflammation of the external meatus.

In examining the membrana tympani the points to be noted are its color, transparency, lustre, light cone, inclination, curvature, entirety, tension, whether adhesions are present or not, and the position of the malleus, especially of its short process. For a full description of these we must refer the reader to Politzer's 'Beleuchtungsbilder des Trommelfills im Gesunden und Kranken Zustande,' Wien, 1865, but the following short note of changes seen in the most common affections in which it is implicated may be found useful in diagnosis. In acute inflammation the membrane is smooth and glistening, and more or less red according to the amount of hyperæmia present. When the mucous layer is hypertrophied, and accordingly a greater amount of secretion present than in the normal state, the membrane is less shining than natural, and has a whitish-gray parchment look. If there is a considerable accumulation of mucus which has lain in contact with the membrane for some time, it assumes a sodden appearance as if the parchment had been steeped in fluid. The changes of inclination and curvature of the membrane depend upon closure of the Eustachian tube, adhesions to the other walls of the cavity, accumulations of pus, mucus, or tumors, internal or external to the cavity, and perforations or thinnings of the membrane, and can only be diagnosed by seeing numerous cases at an aural clinique. The fact that usually only one eye is brought to bear at a time on the membrane makes it

FIG. 114.



Appearance of membrana tympani, showing the relation of parts to each other. (Right ear.)

difficult for the observer to judge of displacement, protrusions, or any changes in which the judging of distance is required till he has accustomed himself to the use of one eye only.

Chronic perforation of the membrana tympani is one of the most common affections of the ear on which you will be consulted. The diagnosis of the affection is easy, either by the speculum, by asking the patient to drive a current of air by a forcible expiration through the Eustachian tubes, the nostrils and lips being held firmly together, —this method being called Valsalva's method—by passing a current of air from Politzer's bag, as described under malformations of the external ear, or by passing the Eustachian catheter and forcing a current of air from the mouth or from an India-rubber bag through the catheter. By these three last methods you will obtain—the Eustachian tubes being open—a sound more or less of a hissing character, depending upon the rush of a column of air through a small orifice. The usual causes of the perforation of the membrane apart from those of a traumatic origin are scarlet fever, measles, tuberculosis, and any greatly debilitating affection in which the mucous membranes are affected.

The prognosis is regulated greatly by the dyscrasia present, but it ought always to be remembered that a perforation may heal without leaving any discernible pathological changes, and without in the slightest recognizable degree lessening the power of hearing. The hopes for such a happy result are the greater the shorter the acute attack which has caused the perforation, while it is rare after a chronic affection accompanied by otorrhœa; but no opinion ought to be hazarded till you have carefully washed out the ear and seen the extent of the perforation and losses which have already resulted therefrom. The process of healing is known by a gradual diminution of the secretion and of the perforation, the cicatrix being formed by the dermoid and mucous layers, but of a much more delicate structure than the natural layers, and not separable into laminæ. The hopes of cicatrization are at an end for the time when the edges of the perforation become cicatrized and a gap still remains, but a new impetus may be given to the regeneration by any future affection which causes a hyperæmia in the part and a softening of the cicatricial edges of the perforation.

In the treatment of a perforation the rule is to close it if possible, on account of the exposure, caused by the perforation of the tender mucous membrane of the tympanic cavity to cold air or water, dust and other foreign bodies. These by their irritation may cause a purulent discharge, and that being once present may lead to results of the most disastrous nature. But if the perforation have existed some time, and be of considerable extent, the question arises whether the closing of the perforation will not impair the patient's hearing power, and before doing anything to close such it is advisable to temporarily close the gap by a drop of glycerine or other thick fluid and note the effects. Should the result be to lessen the hearing power to any considerable extent, you must carefully consider the probabilities before determining upon your action. While the affection is still in the acute stage, the keeping of the parts clean by gentle injections, and the use of some slight astringents for the purpose of reducing the secretion of the membrane and bringing it into a more normal condition, are all that are required, with the use of a little wadding in the ear when the patient goes out, unless the weather is very mild, when the latter may be dispensed with. Should discharge be present which by some means has become thickened, and by its presence closes or tends to close the Eustachian tube, Politzer's operation ought to be done now and again; and if this is not sufficient of itself the softening of such an accumulation by an alkaline solution as bicarbonate of soda ʒss–ʒj to an ounce of water, and then the Politzeration will suffice to remove it. Should you determine to try to close a large perforation you carefully and gently stimulate the edges of the perforation by the application to them of nitrate of silver or other irritant, either in solution or by touching the moistened edges with a thin layer of the crystals placed on a probe as mentioned in the treatment of granulations, or by abrading the edges with a knife, conical file, or plug of wadding, turned in the perforation. But if you fail to close it by the growth of new cicatricial tissue, and yet believe that its closure would improve, or at least not impair, the hearing capability, you may resort to the artificial drum, the success of which in some cases is very great. Numerous modifications of artificial drums have been proposed, but the most simple, most easily applied, and one that is as successful as any other, is a piece of cotton wadding moistened in water or some antiseptic solution, and applied over the perforation and lapping considerably over the edges. The difficulty of its use is its first adaptation, but if once applied successfully the patient can adapt it in future for himself more truly and quickly than his medical attendant. The conclusion as to whether it will be of benefit or not must only be arrived at after several attempts have been made, changing the point of pressure and adapting it more closely to the remnant of natural membrane at different points at each attempt. When it has been used for some time with success the patient feels it very inconvenient to be without it. If found of service, it ought not to be worn above an hour or two at a time for some days, gradually increasing the duration of its application, but always removing it at night, and the patient should be directed to attend to the most perfect cleanliness at each renewal of the wadding. How the artificial membrane acts is still a matter of doubt. It is considered that it is a support to the ossicles and membranes, and this is probably its action in the majority of cases. From observations at the different positions in which they increase the hearing power, I think they may have also a resonating action.

Artificial perforation of the tympanic membrane.—Having spoken of the means of closing a perforation, it is convenient here to speak of artificial perforation of the membrane. The operation is recommended in cases of accumulations of pus or mucus within the tympanic cavity, of impassable stricture of the Eustachian, of thickening of the membrane, of adhesions of the membrane to the tympanic walls, in cases of tinnitus, and in cases where no benefit is derived after prolonged use of other curative means and the diagnosis is not clear, but the acoustic is not much affected. That benefit may be derived in all such cases cannot be denied, but unhappily we are not yet in a position to say that perforation will benefit this or that case, except in cases of accumulation. The point of operation is determined in cases of accumulation by the point of the membrane at which bulging is present, while in other cases a spot behind the manubrium is usually chosen. Bringing the membrane well into view by the usual method, the operation is made by means of one of the numerous instruments which have been proposed for the purpose. If it is merely as an experimental proceeding, to determine whether an opening will be of benefit to the hearing, or for the purpose of allowing the exit of pus or mucus, a small, plain, double-edged scalpel is all that is required. Having made the opening sufficiently large, you remove all impediments to the passage of sound by causing an air douche to be passed through the cavity by one of the usual methods, having, if necessary, previously softened any accumulations. It being thus empirically determined that a permanent opening in the membrane would be desirable, you attempt to keep the opening from closing by a bougie or Politzer's eyelet, by making the perforation by the galvano-cautery, by removing a part of the malleus with a portion of the membrane, by the constant use of the air douche, by repeated removals of the cicatricial membrane, by digestion with pepsine, acids, &c. But as yet no method has been proposed which acts with certainty of success.

The ordinary *affections of the middle ear* which the general practitioner will be called upon to treat are included under the title of "catarrhal affections," and may be of an acute or chronic character. The principal objective symptoms of acute catarrh are a hyperæmic swelling of the mucous membrane, with an increased secretion therefrom, the pharyngeal mucous membrane near the orifice of the Eustachian tube leading to the affected ear being nearly always implicated. This state of the mucous membrane gives to the observer who passes a current of air through the Eustachian tube and listens by means of an otoscope, one end of which is placed in the meatus of the patient and the other in his own, sounds ranging from a harsh dry sound, like that caused by distending a dry bladder, to a true mucous râle. The tympanic membrane varies in appearance, according to the stage of the affection, from that of a glancing polished copper plate to that of a dull wet bladder, from which all bright reflex has gone, corresponding to the dry and infiltrated states of the tissues. A more or less obliteration of the malleus may be present, depending upon the passage of the exudation between the layers of the membrane. A bulging of the membrane will be observed should an accumulation of fluid have taken place to a considerable extent. The chief subjective symptoms are a pain in the depth of the ear, which is increased by every motion of the parts, such as by coughing or swallowing, an impairment of hearing, a feeling of heaviness, fulness or pressure in the ear, often described as a "drop of water in the ear" tinnitus of various characters, as singing, knocking, or surging, the position of which, whether outside or inside the head, the patient cannot always tell, giddiness, confusion of thought, and other symptoms of pressure. The subacute form is merely a combination of the same symptoms in a milder degree. If the case is properly attended to while in the acute stage no graver disturbances of the organism ought to arise, but it must always be remembered that the tendency of the affection being to thickening and swelling of the membranes implicated, adhesions and solderings are apt to take place between the closely situated delicate structures of the tympanic cavity. The general position of such adhesions is between the manubrium and promontory, the tympanic membrane and incus or stapes, the tendon of the tensor tympani and stapes, and especially often in the niches of the two fenestræ, binding the walls together or to the stapes.

But should the acute stage be neglected the acute passes into the chronic form, generally, like the acute, implicating both tube and cavity. It may, however, be localized, and consist in repeated swellings with gradual condensations and thickenings of the mucous membrane, which becomes gradually less elastic, and by proliferation form bands in the cavity. These by their physical qualities as well as by their interference with the swinging faculty of the sound-conducting apparatus materially interfere with the hearing capabilities. This chronic form, once established, is most obstinate to treatment, and leads to increase of the deafness, which depends more on the locality of the changes than on their extent. It also causes an increase of the symptoms of pressure, the tinnitus possibly becoming so harassing that persons have been known to have committed suicide to escape from it, and often causing such depression by the effects of the vertigo and vomiting which it occasions that an inclination to resort to intoxicating fluids is thereby aroused.

The prognosis is generally favorable, but the treatment is prolonged over such an extent of time that the patient frequently ceases to attend before restoration is accomplished, or aid is not sought in time to prevent changes which, having once occurred, cannot be undone. In these cases we must endeavor to stay the course of the disease, which if left to itself will certainly lead to total deafness. The older the patient, the more chronic the affection, and the greater the changes formed in the tympanic cavity, the less hope is there of a good result. If the tinnitus is continuous and has been present for some time, the prognosis is unfavorable, even although under treatment the hearing power is improved, while if nearly total obliteration of the cavity has occurred, especially if chalky deposits are present on the tympanic membrane, a favorable prognosis is almost negatived.

The treatment, besides the constitutional and hygienic, consists in local bloodletting, while the pain and hyperæmia are present, the application of the air douche, the injection of medicaments to the Eustachian tube and tympanic cavity, the treatment of any naso-pharyngeal affection which may be present, and the performance of different operations on the sound-conducting apparatus. Two methods of passing a current of air into the tympanic cavity through the Eustachian tube have been already described (p. 283). The passage of the Eustachian catheter, used either for the conveyance of air, fluids, or vapors, or for the better guidance into and through the tube of bougies, elastic catheters, or instruments for electrical purposes, is by no means so difficult as is generally believed. The silver catheter with an obtuse angle of from 110° to 120°, is, I find, the most generally useful in the hands of those accustomed to pass it. The caoutchouc ones are apt to break after being used some time, and do not convey to the operator such accurate knowledge of the position of the beak, in relation to the structures over which it passes, as those composed of metal, although the caoutchouc are less likely to make a false passage in the hands of an inexperienced operator. The patient ought to be placed with the external openings of the nares horizontal and opposite to the right shoulder of the operator, who, tilting the point of the nose upwards by the fingers of the left hand, discloses the cavities of the nares more fully, upon the floor of one of which he places the beak of the catheter. Keeping the beak on the floor, he passes it through the cavity and onwards across the pharyngeal space, till it comes against the posterior pharyngeal wall, which, in its normal condition, gives him much the same feeling of resistance which he receives on pressing the catheter against the tense open palm of the hand. Drawing the catheter towards him, and at the same time elevating the end which he holds in his hand, he brings the concave curvature of the opposite end against the posterior edge of the nasal floor, and then turning the beak outwards and upwards, keeping it at the same time against the external lateral wall of the pharynx, he will feel it make a slight dip into the pharyngeal opening of the Eustachian tube. The above method is the one usually adopted, but there is that proposed by Bonnefont, which consists in turning the beak of the catheter from the posterior pharyngeal wall outwards into Müller's depression, and drawing it then towards you till you feel that it has passed over a swelling and then fallen into a depression; or Luwenberg's, consisting of turning the catheter beak inwards after reaching the post-pharyngeal wall, drawing it towards you till the curve catches on the posterior edge of nasal septum, and then revolving it upwards or downwards towards the lateral pharyngeal wall, when it will probably pass into the tube. If there is a difficulty in passing the catheter through the nasal cavity it is generally most easily overcome by keeping the beak towards the external wall and passing along it. But should you fail in passing it through the nostril corresponding to the Eustachian tube, into which you desire to introduce it, by using a catheter with a longer curve you can reach the mouth of the Eustachian tube from the other nostril, or you may pass it into the tube from the mouth. You know that the nozzle has passed well into the mouth of the tube by the position of the catheter not being disturbed when the patient speaks or swallows, by the fact that the nozzle will not pass further upwards, and especially by the fact that on blowing air into the catheter, either by mouth or India-rubber bag, you recognize its passage into the tympanic cavity of the patient by having placed a tube of communication from his meatus to your own. In children the outward turn of the catheter is usually more limited in extent than in the adult, in whom it is generally from a fourth to three-eighths; but a latitude must be allowed, as the formation of the part varies. In a new patient, if you wish to pass the catheter into the Eustachian tube, it is advisable to try the right side first, as it will be found usually easier to pass on that side on account of the septum gently inclining towards the left. The mistake generally made is that the catheter is not brought sufficiently forwards after having reached the posterior pharyngeal wall, so that the beak falls into the depression posterior to the opening of the tube. But this may be easily averted by attending to the directions above given as to the feeling pressure of the curve on the back of the septum or soft palate before turning the beak outwards.

Dr. Weber-Liel, of Berlin, has lately introduced a small elastic catheter for the purpose of securing the passage of injections directly into, or the removal of accumulations from, the tympanic cavity. This is passed through the usual silver catheter as a director to the tube, and having thus, on its exit from the silver catheter, obtained a position in the tube, it is passed on with a little care through the tube and into the tympanic cavity.

The injections passed through the catheter consist of preparations of potass, ammonia, iodine, mercury, silver, zinc, atropine, chloral, &c., in solution, care being taken that the fluid is lukewarm at the time of entrance.

The following solutions may be found useful: Sulphate of zinc in varying strengths from one to ten grains, of muriate of ammonia five to twenty grains, of iodide of potassium ten to sixty grains, iodine one to five grains, chlorate of soda five grains, to the ounce of distilled water. Before using them always see that the tube is pervious and cleared of mucus or other removable obstruction to their entrance. They are probably most useful when employed every second or third day, for from three to eight weeks, after which an interval of a month or more of rest is advisable before continuing their application. The injections through the elastic catheter, passing directly into the tympanic cavity, ought to be much weaker.

Should objections be made to the passing of the catheter, so that you cannot use it in passing fluids or vapors to the ear, the instruction of the patient in doing Valsalva's method of inflating the tympanum, by which he may drive steam, impregnated with a little iodine and acetic ether, will serve the purpose. The method of doing so is as follows; Having placed from ten to twenty drops of a solution consisting of equal parts of tincture of iodine and acetic ether in a pint of hot water, the patient inhales a mouthful of the steam, and, having closed the nostrils with the fingers, makes a violent expiration, keeping the mouth and nostrils firmly closed. The steam by this forcible expiration is driven against the walls of the naso-pharyngeal space and mouth, and the Eustachian tubes being the only spots for exit, rushes up these and fills the tympanic cavity, a sensation of fulness, and possibly warmth, being felt in the ear by the patient if the operation has succeeded. This ought to be done several times at a sitting, the patient swallowing between each inhalation. But should the Eustachian tubes be not rendered pervious by the force used, as is not unfrequently the case when the mucous membrane is considerably swollen, the catheter must be resorted to, as by the passage of a current from and India-rubber bag directly through the catheter to the tube an obstruction which will not give way to Valsalva's method will be overcome.

The treatment of the naso-pharyngeal space consists in topical application to the mucous membrane of the space of astringents such as alum, tannin, or nitrate of silver. A very useful form is the drawing of a solution of alum up the nostrils, allowing it to pass back into the pharyngeal space, expectorating it, and then blowing the nose violently. When the alum is thought not sufficient for the condition present in the pharynx, a nitrate of silver solution of from ʒss–ʒj to the ℥ of water applied to the pharynx, and especially to the membrane round the Eustachian regions, will be found a valuable agent. The patient being seated so that good light is thrown into the mouth, and the tongue being depressed by a tongue spatula or the index finger covered by a stall, he is desired to take a deep inspiration, at which moment the surgeon takes the opportunity to pass the brush, which has been dipped in the solution, to one of the Eustachian regions, and making a half revolution upwards, passes over the whole roof of the space to the Eustachian region of the opposite side. The use of gargles at home between the applications of the caustic is to be recommended.

Professor Gruber and others use what is called the nasal douche, by driving from a syringe, the nozzle of which fills one nostril, the other being closed by the fingers of the operator, a current of some astringent solution up one nostril and so into the other, the obstruction to its exit from the other nostril by the fingers regulating the force with which it acts on the pharyngeal walls. But it is so difficult to regulate that force with the resistance of the Eustachian tubes, that the fluid may pass into the tympanic cavity with such a rush as sometimes to do serious damage, and accordingly I would not advise its being applied by those unaccustomed to its use.

The operations on the tympanic membrane and structures of the cavity are perforation, division of adhesions and tenotomy of the tensor tympani. The perforation of the membrane has been spoken of at p. 293. The division of adhesions and of the tensor tympani is made by small curved bistouries or by revolving cutting hooks made for the purpose. Those of Weber-Liel, and Gruber, will be found most useful. The determination of adhesions, with their exact positions, is best made by using Siegle's pneumatic speculum, by which, on creating a vacuum in the meatus, you are able to note what part of the membrane is bound down and does not fall into the vacuum with the rest of the membrane. It requires a considerably lengthened experience in aural diagnosis to be certain of the necessity for or advantage to be derived from such operations.

Otitis media or purulent catarrh is merely a higher grade of inflammatory mucous discharge, but it has always a much more unfavorable prognosis than simple catarrh. The symptoms are much the same as in simple catarrh, but more violent, being accompanied with severe pain, fever, and nearly always leading to perforation. This, should there be an accumulation of considerable extent in the cavity, is to be desired rather than feared; because should the membrane not give way, as is apt to be the case in a thickened membrane from chronic catarrh, the pus is apt to find its way through some of the many passages which often exist between the tympanic and cerebral cavities, and so cause meningitis.

The treatment is conducted on the usual principles. Give the pus every opportunity of free exit, either by natural or artificial channels, and thus allay fever and pain and save time and tissue. Leeches, opiates, purgatives, and warm-water injections into the meatus, keeping the Eustachian open so as to have a natural drain, if necessary, perforation of the membrane at the point of bulging, and when otorrhœa has occurred regular syringing of the ear with lukewarm water, to which an antiseptic or astringent has been added, are what are generally found successful. To make the astringent employed pass into the cavity and through the Eustachian tube it is useful to fill both canals with the astringent, causing the patient to keep it there till you pass a current of air through the Eustachian, on which the fluid in the external canals will rush into the cavity and Eustachian; or by driving a current of fluid with or without medicaments through the Eustachian tube and tympanic cavity from one side or other. In addition to the local treatment that of the constitution must be attended to, the residence of the patient in such chronic discharges being of especial importance.

The pus catarrh of children is often most insidious in its progress, and may cause great injury before its presence is suspected. Till a discharge appears, probably the ear has not been looked upon as the seat of any disease, on account of the child's inability to localize its pain or tell of its deafness. The screaming of the child when pus has formed is loud and persevering, especially at night, is increased by every movement, or concussion of the body, especially by movement of the head, and above all, by sucking at the breast, which at last becomes so painful that the child refuses to take the breast entirely, preferring to be fed by the spoon. In nearly all the cases of suppuration in the tympanic cavity which comes before the surgeon, the pus has already made its way through the membrane, and the child is brought to you on account of the discharge from the ear. Should you, however, see the child before the pain is relieved, you may by the timely use of the remedies mentioned as useful in otitis media and the free opening of any enlargement over the mastoid process, with, if necessary, opening into the mastoid itself if there be indications of pus accumulation there, prevent the destruction of valuable structures. The great cause of the affection is scarlet fever, though measles and typhoid fever contribute largely to the number of cases.

When the acute purulent has become chronic there is a wide-spread prejudice amongst both the laity and professional men against the stopping of such a discharge by treatment. This prejudice cannot be too strongly combated, as though in such chronic cases there are generally present slight deafness and only occasionally pain, we can never be certain that complications arising from the constant otorrhœa, such as polypi, paralysis of the facial, ulceration, caries and its results, will not occur.

Affections of the labyrinth.—The chief symptoms of this class of cases are great deafness, gradually or suddenly acquired, diagnosed by the patient's inability to hear the vibrating fork when placed on the bones of the skull, vertigo, tinnitus, with possibly nausea, vomiting, and pain. The conditions causing such affections are believed to be hyperæmia of the labyrinth or hemorrhage into it, inflammation of the labyrinth, which is generally in children considered under the term of meningitis and malignant affections. But affections of the internal ear are much more numerous as secondary affections resulting from an extension of disease of the middle ear, meningitis, fevers, tumors, aneurism, anæmia, hysteria, childbirth, or syphilis. With the latter, arising from hereditary syphilis, are generally seen the syphilitic physiognomy, and in all the cases which have yet come before me in which the acoustic was considerably impaired, changes in the choroid were invariably found if the media were sufficiently clear to allow of a view of the retina being obtained. The treatment, should syphilis be the cause, is not entirely hopeless, but if from other causes is almost nil. Strychnia, quinine, morphia, and local remedies have their different advocates. Electricity may be tried, but a sufficient number of carefully recorded cases is still required before an opinion of its value can be given.

Deaf-mutism.—By far the majority (above three-fourths) of the cases of deaf-mutism arise from congenital affections, the remainder resulting from fevers, teething, hydrocephalus, convulsions, &c. The hereditary influences are undoubted, and when such are present it is often seen combined with retinitis pigmentosa. The pathological conditions found in such are changes in the tympanic cavity with defects in the sound-conveying apparatus, abnormalities in the labyrinth or cerebrum, especially near the fourth ventricle. But the inner ear or cerebrum may have no perceptible changes sufficient to account for such a high degree of deafness as is present. The treatment is the careful cultivation of any remnant of hearing which may be present, and the placing of the child in an institution for the education of deaf mutes, where by the careful watching of the lips of the speaker they are able to follow him in conversation, and by a laborious teaching of the positions in which the organs of speech are to be placed in forming the different syllables, they are rendered capable of answering.

SURGERY OF THE CIRCULATORY SYSTEM.

CHAPTER X.

WOUNDS OF THE HEART AND ARTERIES—HEMORRHAGE AND ITS TREATMENT.

WOUNDS OF THE HEART.

ALTHOUGH it is quite possible for the anterior mediastinum to be traversed from side to side by a foreign body without any important structure being wounded, it is far more common for some severe lesion to be the result, such as a wound of the pericardium, heart, lung, or of the great vessels. A wound of the *pericardium alone* may occur, and not prove fatal. Dr. G. Fischer has collected fifty-two reputed cases of this nature, including punctured, incised, gunshot, and lacerated wounds, twenty-two of which recovered. The chief danger of this local injury lies in secondary inflammation of the membrane. From a unique preparation shown by Mr. Morant Baker in May, 1877, at the Pathological Society, it would seem that an omental or other hernia may take place from the abdominal cavity through the diaphragm into the pericardium by an aperture, the result of some antecedent stab. The operation of "paracentesis pericardii" has been performed with advantage.

Wounds of the heart itself are generally mortal, death taking place immediately in about one-fourth of the cases; in the bulk of the remainder after a few days; rare instances recovering. The symptoms of a wound of the heart are very uncertain, but the most important, says Poland, "is the presence of a *lesion* in the neighborhood of the heart, with *external bleeding*, followed by all the signs of sudden internal hemorrhage." Sudden *collapse* is a very general consequence of the injury, and, when it comes on some time afterwards, it is probably due to secondary hemorrhage from the giving way of the clot in the wounded heart. *Dyspnœa*, according to Fischer's Analysis, is not constant, and, when present, seems to be due to compression of the heart by the effusion of blood into the pericardium and pleura. In some cases it is immediate and intense. The *pulse* is often unequal, small, and intermitting. *Pain* is uncertain. The position of the external wound is a valuable aid to diagnosis, and it is well to remember that the sternal end of the second left intercostal space corresponds to the left side of the base of the heart, and the lower margin of the fifth rib to the apex. In a medico-legal sense it should also be known that "when a person is found dead with a wound in the heart, attended with abundant hemorrhage, it must not be supposed that the flow of blood took place in an instant, or that the person died immediately, and was utterly incapable of exercising any power." (Taylor.) The symptoms as well as the duration of life are much influenced by the direction and size of the wound. Thus, if made in the course of the muscular fibres there will be little or no hemorrhage, and consequently less collapse and dyspnœa; but if the heart be cut across, the edges will separate to a great extent, and sudden death ensue from the immediate gush of blood. In oblique wounds there will be less gaping of the edges. With respect to the cases of recovery, Sanson has recorded an instance in which a cicatrix in the heart was found some lengthened period after the receipt of a wound from which the patient had recovered in twenty-eight days. Velpeau has cited a second, of a man, aged fifty, who died nine years after having received a wound in the left side of the chest from a table knife, and in whom the pericardium was found largely opened and adherent to the parietal cicatrix, while fibrous lines traversed the whole thickness of the right auricle, at a point corresponding to the breach of surface in the pericardium. In the 'Medical Times and Gaz.' of April 4th, 1874, a case is also reported of a Captain B—, æt. 40, who died from dysentery, and after death a leaden bullet was found encysted outside the pericardium, between the origin of the pulmonary artery in front and the ascending part of the arch of the aorta behind. The bullet had entered the chest above the nipple eleven years previously. The heart may also be lacerated by a severe contusion or pressure upon the chest without external wound or fracture of the ribs.—(Thus at Guy's there is a prep. 1400^{35}, in which both auricles of the heart are lacerated with the pulmonary veins which was taken from a child, aged four, over whose back the wheel of a cart had passed. There is also another in the Royal College of Surgeons of Edinburgh which proves this point.)—The diagnosis and treatment of this form of injury are the same as in cases of wounds.

TREATMENT.—As hemorrhage after a wound of the heart is the main fear, so to prevent and arrest it should be the chief aim. With this object, absolute repose is essential, and should be maintained throughout the case. The local and general employment of cold is also to be advised. To calm the excited action of the heart belladonna and digitalis have been recommended, and so even has venesection. The diet should be nutritious, but unstimulating. When the pericardium is full of blood, it has been suggested to lay open the cavity to let it out, but the uncertainty of diagnosis is sufficient to forbid the attempt. For further information on this subject I may refer to Poland's article in 'Holmes' Surgery,' which contains an admirable analysis of Fischer's paper; also to a paper by West in the 'St. Thomas's Hosp. Rep.,' 1870.

Wounds of the large vessels of the chest are generally fatal, death being immediate in most cases, from internal hemorrhage. Dr. Heil, however, records a case in which a man after receiving a stab which penetrated the aorta, recovered and lived a year. Pelletan also cites another, in which a man was run through with a foil, which entered the chest above the right nipple, and came out at the left loin; no violent or marked symptoms followed the accident beyond constant pain in the loins. Two months later, he died somewhat suddenly, in great agony from hemorrhage into the right side of his chest, and after death, an opening the size of a quill, was found in the aorta above the diaphragm. The Hunterian Museum (No. 1565a) contains a specimen of the ascending aorta of a sailor, in which was lodged a bullet in a piece of integument surrounded by lymyph. The wound was produced by a musket ball passing through the diaphragm and pericarwn into the aorta; it entered the chest between the eighth and ninth ribs, and was lowed by a rush of blood. All hemorrhage, however, very soon ceased. The man ed three days after the injury.

Wounds of the Arteries.

When an artery is *completely cut across* bleeding may take place, the blood jetting rth *per saltum*, as it is called, with each pulsation of the heart. The blood is usually of bright red color, unless the patient be asphyxiated, or fully under the influence of some næsthetic, when it is often as black as venous blood. Pressure upon the vessels above e wound arrests or diminishes the hemorrhage, and pulsation in the vessel below is lost. When, however, an artery is *only partially wounded*, either transversely, obliquely, or ongitudinally, the bleeding will probably be less profuse; the blood, under these circumtances, moreover, rarely jets out as from a divided vessel unless the wound be very large, ut wells up *in a deep wound*, or flows in a continuous stream, after the manner of venous blood. When red, its arterial nature can easily be recognized, but when black its recognition is more difficult. Should pressure, however, above the wound arrest the flow, and pulsation in the vessel below be lost, the probabilities of the blood being arterial are strengthened. It is an important fact to bear in mind, that when a large artery is partially divided just *below* a large anastomotic branch, bleeding will take place from the lower end of the wounded artery as well as from the upper, while pulsation in the vessel below will only be diminished.

When hemorrhage takes place from a large vessel it is generally so profuse as to destroy life rapidly, unless instantly checked. When from a small it is less copious, and has a natural tendency to stop, at any rate for a time, and to give an opportunity for natural hæmostatics to take effect. It is well, therefore, to consider now how wounded arteries heal, and by what means bleeding can naturally be arrested.

Small wounds of arteries may, doubtless, heal by immediate union or primary adhesion, and larger may likewise for a time be closed by the clot of blood that covers the wound, or even by some stronger reparative material; but "the closure is often ineffectual or only for a time, and fresh bleedings ensue, either increasing the accumulation of extravasated blood or pushing out the clots already formed. In this manner, with repeated hemorrhages at uncertain intervals, the wound in an artery is often kept open, and at the end of two or three weeks may show no trace of healing, but rather appear widened and with softened everted edges. In such a case it is possible that the wound in an artery may still *heal by granulations*, either rising from its edges or coalescing over it from adjacent parts; but the *event is too unlikely to justify the waiting for its occurrence*, if there be opportunity for surgical interference, and, even if healing should go so far as to close the opening in the artery yet it is likely to be insecure, for both the elastic tissue and smooth-fibred muscle on which its strength largely depends, are very slowly formed in scars. Hence, a form of traumatic aneurism seems not very rare, in which the sac is chiefly formed of scar-tissue, which closed the wound in the artery and then yielded to the pressure of the blood."—Paget, 'Lectures,' p. 204, ed. 3d.

Thus a partial is a more serious injury than a complete division of an artery, and requires as prompt surgical treatment, because the means adopted by nature in a divided vessel for the permanent arrest of bleeding are acting at a disadvantage in the one only wounded, and are rarely effectual. In practice, therefore, it is often the object of the surgeon to complete the division of a partly divided vessel, and thus to give natural hæmostatics a fair chance of effecting a cure. From vessels of small size hemorrhage, as a rule, ceases after the first rush or, at any rate, as soon as nature's processes for controlling bleeding have had time to act. Indeed, "gradually, with or without surgical help, all the vessels divided by a wound are closed and cease to bleed; the larger being often aided to this end by their retraction among the looser textures, and by the coagulation of the blood within or over their orifices, and by the diminution of the heart's force with the increasing loss of blood. Coincidently the flowing blood becomes gradually brighter and paler. And, f the wound be left open after pure blood has ceased to flow, there is an oozing of bloodinged serous-looking fluid; and this is gradually succeeded by a paler fluid, some of which ollects like a whitish film on the surface of the wound."—Paget.

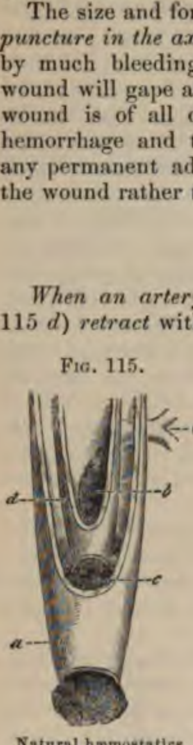
Whatever favors retraction of a divided artery and its contraction, tends to arrest leeding; whatever hinders these processes prolongs and increases it. Thus, vessels that raverse loose textures cease bleeding more readily than others circulating through those hat are close and compact, such as the integument of the head, and sole of the foot; and bleeding from an inflamed or rapidly growing part is checked with greater difficulty than that from other tissues.

The size and form of the wound in the vessel has also much to do with the result. A *puncture in the axis* of a large artery may heal by natural processes and be unattended by much bleeding. A small *vertical* wound may likewise close, whereas an *oblique* wound will gape and is, consequently, attended with copious bleeding, while a *transverse* wound is of all others the most dangerous on account of the difficulty of controlling hemorrhage and the improbability of natural hæmostatics unassisted by art acting with any permanent advantage. The retracting power of the vessel tends to cause gaping of the wound rather than closure, and encourages rather than checks bleeding.

NATURAL AND SURGICAL HÆMOSTATICS.

When an artery is divided across, five things happen. (1) The divided ends (Fig. 115 *d*) *retract* within the sheath (*a*), and (2) by *contracting* diminish the calibre of the canal. (3) Blood coagulates *in the sheath* (*a*) around the orifice of the divided vessel; and (4) *in the artery* itself (*b*) up to the first large branch (*e*); and, lastly (5), *plastic lymph* is poured out from the divided coats of the vessel, and by its organization, the permanent closure of the vessel takes place. The clot subsequently becomes organized and the vessel contracts. In a large proportion of the cases of divided arteries these natural hæmostatic processes are ample of themselves for the arrest of bleeding, while it is only in the larger arteries that any surgical or artificial aids are required.

FIG. 115.



Natural hæmostatics.

When an artery is torn across, the same changes take place; *but they are carried out to an advantage*, as the stretching or torsion of the vessel before it gives way encourages its retraction and contraction, and the lacerated edges of the vessel help the coagulation of the blood. It thus often happens that when a large artery is divided by laceration no bleeding occurs. I have seen the femoral and brachial arteries torn asunder and no bleeding follow, and whole limbs avulsed from the trunk without hemorrhage. The lacerated vessel appears under these circumstances as if drawn out, the elastic external tunic being stretched into a conical form over the inner coats that have been divided and have retracted. An artery divided by laceration or torsion, however large, consequently rarely bleeds, and it was the knowledge of this fact that suggested to Amussat the idea of practising torsion of an artery.

FIG. 116.

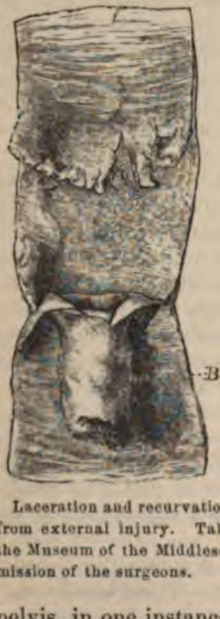
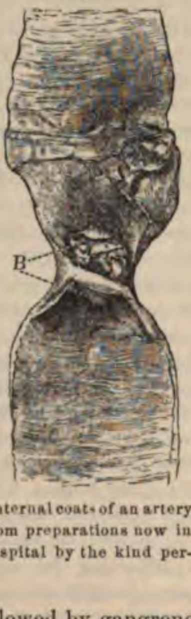


Fig. 117.



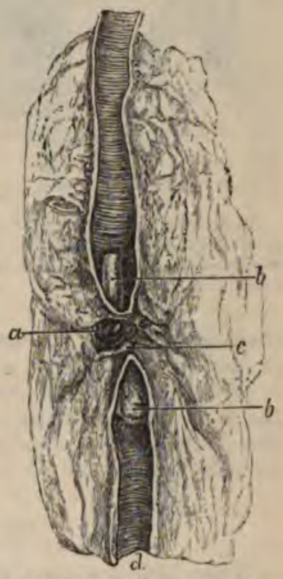
Laceration and recurvation of internal coats of an artery from external injury. Taken from preparations now in the Museum of the Middlesex Hospital by the kind permission of the surgeons.

When an artery is contused or so stretched as to suffer something less than complete rupture of all its coats, it may become obstructed; and this obstruction is probably caused by a more or less complete circular laceration, or breaking up of its inner tunics; for the different museums contain preparations which prove that an artery so treated, when apparently maintaining its continuity, may have a complete circular laceration ot its inner coats, a separation of these coats from the external cellular one, or an incurvation of these tunics into the lumen of the artery, as in torsion (B, Figs. 116–7); the deposition of clot subsequently taking place within the meshes of the divided coats, and, as a consequence the complete occlusion of the vessel.

I have known this obstruction to follow many injuries, and have seen the external iliac artery obstructed in a case of a broken pelvis, in one instance followed by gangrene of the lower extremity, and in a second by cure. I have also known the common femoral artery, the superficial femoral artery, the axillary and brachial arteries to become permanently closed in a similar manner. It is a question, indeed, whether, as a result of contusion, adhesive inflammation ever takes place in an artery to cause its occlusion without some such laceration of its inner tunics as has been described.

Sometimes a vessel will rupture some days after the injury, at a part that has been severely contused, causing a secondary subcutaneous hemorrhage, and the sensation of something giving way. Such a result, however, is rare in civil practice; although in military, from gunshot wounds, it is more frequent. The bleeding under such circumstances occurs after the fifth day. Cold lotions will, generally, suffice to induce absorption of the blood when the hemorrhage is slight, although in some cases the fluid blood may be drawn off with a good result. In exceptional cases, an aneurism may form and requires treatment.

FIG. 118.



Effects of carbolized catgut ligature on common femoral artery, taken from a girl æt. 19, who died on the 20th day from gangrene leg after the application of the ligature to the artery for elephas. The ligature in the case was firmly attached to the vessel, and had acted upon its coats as a permanent ligature.

It having been asserted that it is by natural processes alone that divided vessels are permanently sealed, and arteries in continuity occluded, it will be well to inquire into the modes of action of the different means which the surgeon has at his disposal to bring about these results; and it may be stated *in limine* that the means are to be regarded as good, in so far as they aid the natural processes that have been described and turn them to account.

Thus, the *exposure of, and the application of cold to*, a divided artery favors its contraction; this physiological fact explaining the practical—that on the free opening of a wound, hemorrhage so often ceases never to return.

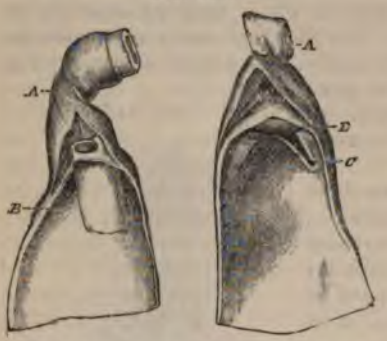
Pressure upon the end of a wounded artery favors coagulation in the vessel, and the value of *acupressure* rests mainly upon this principle, as the pins mechanically arrest the flow of blood, whilst coagulation is taking place in the vessel up to the first branch.

When a ligature is applied to an artery the inner coats are usually more or less regularly divided, and the outer is so constricted as to arrest the current of blood through the vessel. The blood thus arrested consequently coagulates and forms a clot or thrombus, which is, as a rule, conical with its base towards the ligature and apex pointing to and reaching the first branch. (Fig. 118 *b*.) This clot subsequently contracts and becomes organized. The inner and middle coats, from their divided edges, pour out (*c*) plastic lymph, which heals the wound, and eventually cements the outer and inner coats, which with the clot unite together into one homogeneous mass; and if in the sequence of events nothing occurred to interfere with the steady evolution of this reparative process all would indeed be well, but unfortunately such is not the case, for the ligature, when composed of silk, hemp, or wire, and called permanent, has to come away. To this end the outer coat of the artery where constricted, must slough or ulcerate, and the vessel itself, in either case, at the line of ligature thus becomes divided. By such action, therefore, what nature might have well done by the processes already described too frequently becomes undone, and unless a firm clot has filled both ends of the artery, or plastic lymph become organized around the divided coats, the probability that secondary hemorrhage will take place is very great. It is this fact which makes the practice of arresting hemorrhage by means of the permanent ligature so unsatisfactory. To Stilling and Dr. J. F. D. Jones we are indebted for most of our knowledge on these points.

When, however, the carbolized catgut ligatures are employed, the secondary changes which have been described do not of necessity occur, although in their primary effects the catgut ligature acts precisely as the permanent (*vide* Fig. 118; 'Trans. of Clin. Soc.,' 1878). The carbolized catgut ligatures are to be regarded as temporary ligatures, which may either dissolve within a few days of their application or become loose. If, therefore, an artery to which such a ligature has been applied does not become permanently closed by natural hæmostatic processes before the catgut ligature has dissolved or become loose, the circulation through the vessel may be restored or secondary hemorrhage may ensue; this accident has occurred in my own practice. The catgut ligature is not, therefore, so safe as torsion for divided arteries. It is, however, a safer ligature than the silk or hempen as it does not, like the latter, of necessity require an ulcerative process for its discharge.

When an artery is closed by what is termed Torsion the inner coats are ruptured (Fig. 119 B and C), and the outer (A), when not twisted off, closed by the twists to which it has been subjected. But the inner coats, instead of being simply divided in a linear manner, as occurs when the ligature is used, become ruptured, separated from the outer coat and incurved, their divided ends turning into the vessel, and in the most perfect examples forming complete valves, not unlike the semilunar valves of the heart. The blood, which is consequently arrested by this valvular incurvation of the inner tunic, undergoes changes precisely similar to those already described. Plastic lymph is poured out by the divided tunics in the same way as has been shown in the application of the ligature, and it acts the same part in cementing all the arterial tunics and clot together. Between the two forms of practice, however, there is this difference, that where the ligature has been used, ulceration of the vessel is necessary to allow of its escape, and this may undo all that Nature has done to seal the artery and prevent hemorrhage; whereas, when torsion has been efficiently performed and the hemorrhage arrested, no subsequent action is liable to undo the good work that has been done or hinder the permanent closure of the vessel.

Fig. 119.



Effects of torsion upon an artery, showing the incurvation and laceration of the inner coats. From paper by the author, 'Med.-Chir. Trans.,' 1868.

With both ligature and torsion, natural hæmostatics are aided in their work; but with the former the ulceration set up by the ligature may materially interfere with the perfection of the process; while with the latter there is nothing to prevent the process going on to its completion.

On Hemorrhage and its Treatment.

When bleeding takes place rapidly from a wound after an injury or operation, it is called *primary;* when it occurs within twenty-four hours or in rare cases within two days, it is called *recurring or intermediary*, and, when after a lapse of a longer period, *secondary*.

The *primary* is due to the direct injury of the vessel; the *recurring* to the increased force of the circulation during reaction, and the displacement of clots that were sufficient to seal vessels when the circulation was feeble; to the overlooking of a vessel during the dressing of a wound, or, to some imperfection in the mode of securing it at the time of operation. The *secondary* is caused by the giving way of an artery or vein; by ulceration of the ligature; by sloughing of the vessel alone or with the tissues around; by the accidental separation of a ligature; injury; or owing to the hemorrhagic diathesis.

When blood escapes from a wound externally or into a cavity, the term *hemorrhage* is applied; when beneath the integuments or amongst tissues, *extravasation* or *effusion* is said to occur.

The symptoms of external hemorrhage require no description; the slow flow or the sudden gush of the life's blood being recognizable by all. Those of concealed, internal hemorrhage or extravasation require, however, some attention. They are those of local injury, *plus* those general symptoms which denote hemorrhage generally.

"In slow and in sudden hemorrhages," wrote John Bell seventy years ago, "the symptoms are very different. In the former the patient is very slowly exhausted; at each return of bleeding the patient faints, and is laid in bed, and the cold applications and the fainting save his life. He rises, after some days, pale, languid, and giddy. The pulse flutters, and is hardly to be felt; the breathing is quick and anxious, accompanied with sighing and great oppression; the heart palpitates on the slightest motion; and the slightest inclination of the head, or rising suddenly from the couch, endangers fainting. The voice is low; the eye is languid, colorless, and of a pearly white; the flesh feels soft and woolly, and the skin is pale, yellow, gelatinous, and, as it were, transparent, like modelled wax. After this stage of weakness the blood loses its color; from this time forward it is a bloody serum only that distils from the vessels; dropsy appears, and the slightest loss of blood proves fatal. But when the patient expires suddenly by an impetuous bleeding from some great artery; when he dies of the bleeding from a femoral aneurism; when he is wounded among the viscera, and some great vessel is pouring out blood, the blood in the general circulation, in place of being forced onwards by the contractions of the arteries, runs backwards towards the wound from all parts of the body. The arteries no longer push on the contents of the veins; the blood ceases to flow towards the heart; the heart ceases to act; and the countenance assumes, as in asphyxia, a livid hue from want of circulation. The face becomes all at once deadly pale, the circle round the eyes is livid, the lips are black, and the extremities are cold. The patient faints, revives, and faints again; with a low and quivering pulse; he is sick; and his voice is lost. There is an anxious and incessant tossing of the arms, with restlessness, which is the most fatal sign of all. He tosses continually from side to side; his head falls down in the bed; he raises his head at times suddenly, gasping, as it were, for breath, with inexpressible anxiety; the tossing of the limbs continues; he draws long convulsive sighs; the pulse flutters and intermits from time to time, and he expires. The countenance is not of a transparent paleness, but of that clayey and leaden color which the painter represents in assassinations and battles; and this tossing of the limbs, which is commonly represented as the sign of a fatal wound, is indeed so infallible a sign of death that I have never known any one recover who had fallen into this condition." ('Principles of Surgery,' vol. i, page 143.)

This sketch is so graphic that I have extracted it as a whole. Since my student days, when I first read it, it has been fixed in my memory. It is, however, only a page out of the work of a master surgeon which still deserves close study. A patient may lose a large quantity of blood and yet rally. Children bear the loss of blood badly, yet rally quickly. In old age a small hemorrhage is of grave importance, the rallying power being very small.

Hemorrhage from any vessel, however large, is readily controlled by the application of well-applied direct pressure *upon the wounded part*, consequently any surgeon on being called to a case of wounded artery, having cleansed the wound and exposed the vessel, should put his thumb or finger on the bleeding orifice and check the flow. No mere covering up of the wound to smother the hemorrhage will be of any benefit. When moderate bleeding comes from a wound and its source is unknown, whether arterial or venous, the first duty of the surgeon is to *clean the wound and remove clots*. This act alone is often sufficient of itself to arrest bleeding, not only for the time but permanently. The parts at the same time should be elevated and left exposed for a few hours.

When the bleeding is venous, *the elevation of the limb* has a most beneficial and rapid action. In amputations, before the application of the tourniquet, as well as after its removal, the limb or stump should always be elevated for a few seconds to empty the veins. When well applied, *direct pressure* stops the flow of blood, and when such means appear to be sufficient for the treatment of the case, care should be employed in its application. The first pad to be applied to the bleeding part should be small and compact, corresponding in size to the last joint of the thumb; a larger one should be placed over it and carefully adjusted, and a third covering in the whole. These are to be firmly bound down over the bleeding vessel with a bandage or some unyielding strapping. care being taken that the pressure employed is sufficient to control the bleeding, but not enough to arrest wholly the circulation through a limb, thereby producing gangrene of the parts below.

When direct pressure is inapplicable, *indirect pressure*, as it is called, or pressure by means of a tourniquet applied to the main artery of a limb above the wound, may be employed; and in operations upon the extremities, this is the best mode of preventing or arresting hemorrhage, the tourniquet being accurately applied over the main artery, but not screwed up till the operation is about to be commenced.

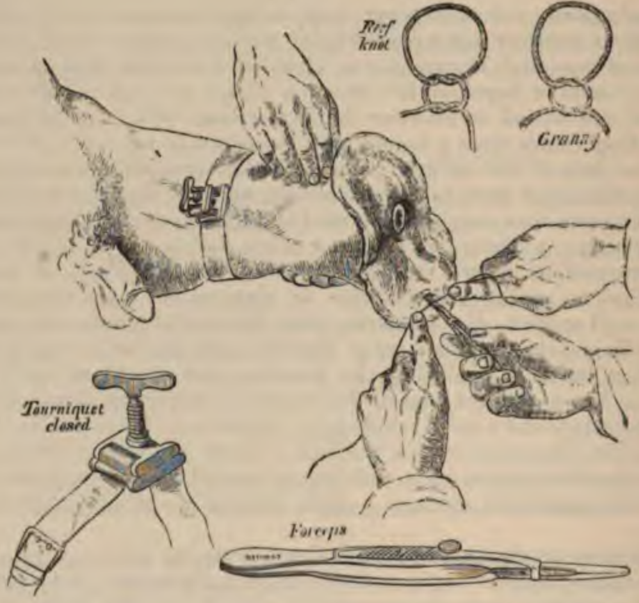
For mere temporary purposes, the main artery may be compressed by the finger of the surgeon or of a skilled assistant; but for a lengthened period, this method is untrustworthy, it being impossible for any ordinary man to maintain firm pressure upon a vessel for more than a few minutes consecutively. The use of the weight as shown in Fig. 131 may be recommended. As a temporary means of arresting bleeding, however, manual pressure is of immense value, and should be applied to the femoral artery below Poupart's ligament for the lower extremity; and on the inner side of the biceps muscle for the upper, the fingers or thumb of the surgeon being employed according to convenience.

In recent times, what is known as Esmarch's method of arresting hemorrhage has met with considerable support. It consists first, in applying an elastic bandage from the extremity of the limb to be operated on to a point above the site of the operation, and secondly, in the application of an India-rubber band or tube, tightly above the upper border of the elastic bandage, which can then be removed. By this method, the parts below the band have been rendered bloodless, and the surgeon may explore a limb, excise a tumor, joint, or bone, and even amputate, with the loss at the time of a spoonful of blood.

The method has, however, one objection, which is that when the band is removed blood oozes from the soft parts to a far greater extent than under other circumstances, the smaller vessels apparently becoming paralyzed by the compressing bandage, or, from their having been completely emptied. The operation which is bloodless during the cutting process is, on the whole, therefore followed by the loss of as much blood as generally follows other methods. For amputations, I never employ now the compressing bandage, but elevate the limb to empty it of venous blood, and, with the hand press the blood upwards. I then use the elastic band or India-rubber tube as a tourniquet, having found by this method that all the advantages of Esmarch's plan are secured with less of the disadvantages. For exploratory operations and the removal of small foreign bodies, excision of joints, and removal of necrosed bone, the compressing bandage has, however, great advantages.

The tourniquet is, doubtless, an excellent instrument for the compression of an artery, and J. L. Petit's is, probably, the best for the extremities. It should be applied to the limb directly over the vessel to be compressed, the pad being adjusted in the axis of the vessel. The ends of the band are then made to pass round the limb, and are secured either by a buckle or a knot, the former being preferable. The two plates can then be separated by the rotation of the screw, and a sufficient amount of pressure employed to stop the current of blood, and no more. (*Vide* Fig. 120.) Lister has invented an admirable tourniquet for compressing the abdominal aorta, and many others have been constructed, but these are ample for all ordinary purposes of arresting or preventing hemorrhage.

Fig. 120.



When a tourniquet is not at hand, as in the field, a stone or any hard substance may be rolled up in a handkerchief, applied over a vessel, and bound round the limb; the ends of the handkerchief too should be attached to a stick or sword, any amount of compression being obtained by simply twisting them.

As *temporary* means of arresting hemorrhage, therefore, pressure upon the bleeding spot, *i. e., direct;* or upon the main artery of the part, *i. e., indirect;* digital or instrumental is the more reliable. The wound in both cases should be well exposed and cleansed, and all coagula removed preparatory to the application of such permanent means as may be at command. Of these, the *ligature*, *torsion*, and *acupressure* are the chief. Styptics and the cautery are only employed when the three means mentioned are either inapplicable or have proved unsuccessful.

ON THE USE OF THE LIGATURE.

Since Ambrose Paré re-introduced the use of the ligature (1550), it has been the favorite means for the arrest of hemorrhage; the speedy way in which bleeding from an artery, however large, is checked by its application, and the feeling of relief experienced on knowing that for a time, at least, all fear of bleeding has been removed, having so influenced the majority of practitioners in its favor, as to induce them to put aside, untried, all other suggested means as being unnecessary. It took, however, more than two centuries for the ligature to become established in practice; in fact, its adoption was not general till Jones had demonstrated by his experiments already alluded to (p. 301), the physiological processes by which hemorrhage is naturally arrested in a bleeding vessel, and, that by the ligature, these were utilized.

To tie an artery efficiently, the vessel should first be taken up cleanly and drawn out. A smooth round cord of silk, hemp, or catgut, must then be applied firmly around its extremity, sufficient force being used to cause rupture of the inner coats of the vessel (such a result, although desirable, not appearing, however, to be constant), and occlusion of the outer coat, a knot called the surgeon's or sailor's reef-knot being employed. In forming the knot, the loop of the ligature should be pressed down to the artery by the finger or thumb as indicated in the drawing (Fig. 120), otherwise the extremity of the artery will be liable to be broken off, particularly if diseased.

When the vessel is deeply placed and cannot be isolated, it must be ligatured with some of the adjacent tissues. When it is so embedded that its free end cannot be taken up with forceps, a tenaculum may be passed beneath the bleeding vessel and all the tissues taken up by the instrument should be strangled by the ligature. The ends of the ligature may be left hanging out of the wound. In later years Mr. De Morgan has been in the habit of cutting off both ends of the ligature, leaving the knot *in sitû* and closing the wound, such a practice being a revival of the last century, and, since carbolized catgut ligatures have been employed, the practice has become general.

When the vessels are diseased and brittle, some care is needed in the application of the ligature. The vessel should not be tied too tightly lest too much of the artery be torn and the ligature be made to separate before natural hæmostatics have closed it. Some have suggested the use of a flat ligature under these circumstances, but it seems scarcely needed. In 1865 I was called upon to apply a ligature to the femoral artery of a man over seventy years of age for femoral aneurism. The vessel was so brittle that I felt the coats give way on the application of the ligature; the included tissue too seemed so thin that I expected to find the ligature come away in my hand, which did not occur. The case ultimately did well, and no bleeding ensued.

ACUPRESSURE.

The late Sir James Simpson brought this method of arresting hemorrhage before the profession in 1860, and on his authority many resorted to the practice. Drs. Keith and Pirrie, of Aberdeen, have given it their warmest support; indeed, at the present time, in Dr. Pirrie's hands it is alone employed as a general way of arresting hemorrhage. The principle of the practice is very simple, viz., the occlusion of the artery by the temporary pressure of a pin, without lacerating the vessel or setting up inflammatory and suppurative action as in the ligature. The pin is removed on the second or third day, according to the size of the artery. The advantages thus claimed for it are very great, but experience has not yet decided in its favor. There are three leading forms of acupressure.

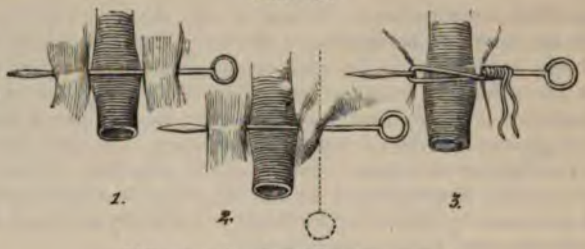
In the *first*, the artery is directly compressed between the pin, which crosses its free end, and the muscle beneath. (Fig. 121, 1.)

In the *second*, the same result takes place, the pin being made to give a half twist through the tissues between its first and second insertions. (Fig. 121, 2.)

In the *third*, the pin is simply passed beneath the vessel and pressure applied to the artery by means of a loop of wire or silk looped over its point and made to cross the vessel, the ends of the loop being secured upon the shaft of the pin. (Fig. 121, 3.)

The *good* point in acupressure is the absence of any foreign body for more than a few hours or days. Its disadvantage lies in the fact that its success depends upon the coagulation of the blood in the vessel down to the first branch, one of nature's temporary hæmostatic processes, and not upon the permanent closure of the coats of the vessel. As a consequence it is not so secure as the ligature, or physiologically so sound as the practice of torsion. As a general mode of arresting hemorrhage it seems improbable that it will hold its ground, indeed it is but little practised at the present time. As a mode of temporarily arresting hemorrhage in certain cases where the ligature and torsion are inapplicable, as in wounds of the palm or the sole of the foot, it is indeed valuable, and particularly also as a means of arresting the flow of blood from a leech bite or other bleeding point—the passage of a needle through the skin, and a figure-of-8 ligature over, being of great service.

Fig. 121.



Different modes of applying acupressure.

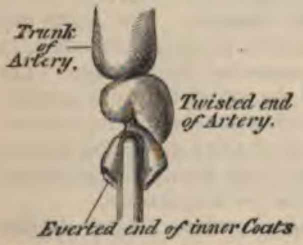
An ingenious modification of this process has been devised and successfully used by Mr. Dix, of Hull. A wire passed through the flaps by means of two needles and twisted over a cork outside, compresses the bleeding vessel in the same way as the needles. It is called by its author "the wire compress," and is fully described in the 'Edinburgh Medical Journal,' Sept., 1864. It seems, however, to be more adapted for securing an artery in its continuity as in the treatment of aneurism, under which head (see page 325) it will be described in detail.

On Torsion.

In a physiological point of view there is no method more perfect at command for the control of hemorrhage than that of torsion; because, unlike acupressure, which uses one only of Nature's hæmostatic processes, or the ligature, which is a foreign body in a wound, and becomes a source of danger by undoing at a later what has been done at an earlier period of the case, it utilizes to the utmost all the physiological processes employed *by* Nature to prevent and arrest bleeding, and places the vessel in the most favorable position for them to take effect. What these changes are was discussed in a former page of this chapter.

For the application of torsion a good pair of forceps is required (*vide* Fig. 120), that will hold the end of the artery firmly, that has no lateral motion, and with serrations blunt enough to obviate any laceration or cutting of the parts seized by the blades. The vessel should then be drawn out, as in the application of the ligature, and three or four sharp rotations of the forceps made. In large arteries such as the femoral, the rotation should be repeated till *the sense of resistance has ceased.* The ends should not be twisted off. In small arteries the number of rotations is of no importance, and their ends may be twisted off or not, as may be preferred. In Fig. 122. the appearance of a femoral artery sufficiently twisted is well shown.

Fig. 122.



Effects of torsion on femoral artery.

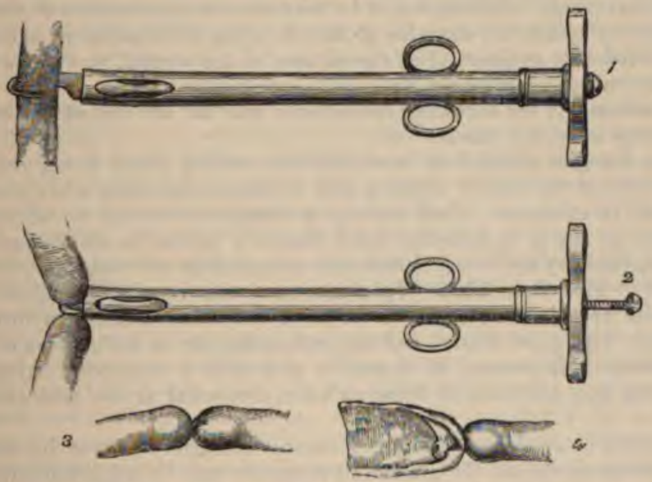
When the vessels are atheromatous or diseased, fewer rotations of the forceps are required, the inner tunics of the vessel being so brittle as to break up at once and incurve. If the surgeon, therefore, twists more, he will break away the external or cellular coat which is not only of essential importance in maintaining the lacerated inner coats in position, but in allowing blood to coagulate, and the lymph to organize between them. With this caution diseased arteries appear to be as amenable to the treatment as the healthy, and torsion requires no more care under these or any circumstances than the application of a ligature.

The physiological arguments in favor of torsion are numerous, while the practical advantages seem to be not less. After nine years' experience of the practice among vessels of all sizes (the femoral being the largest) I have had no mishap. I have further observed, that wounds have united more rapidly and kindly—primary union being the rule; there has been less constitutional disturbance after operation and consequently less liability to traumatic fever, pyæmia, and other complications such as we are all too familiar with, in the practice of surgery. Stumps have healed in a week, and patients been up in two weeks, without one single drawback, rapid and uninterrupted convalescence following the operation. In other cases, equally good success can be recorded. At Guy's Hospital, we have had two hundred consecutive cases of amputation of the thigh, leg, arm, and forearm, in all which the arteries had been twisted (110 of them having been of the femoral artery) and no case of secondary hemorrhage.

The Artery Constrictor.

Dr. Fleet Speir, of Brooklyn, New York, has had an artery constrictor made (Fig. 123) which, as he has demonstrated upon both the living and the dead, has the power of dividing the inner coats of an artery and allowing them to recurve, as in torsion. He has used it on all the larger vessels except the iliac and subclavian, and has never had any trouble, union chiefly by first intention having followed ('Med. Mirror,' New York, April, 1871, and 'Archives of Clinical Surgery,' Sept., 1876).

Fig. 123.



1. An artery taken up by the constrictor. 2. Artery constricted. 3. Effects of constriction upon vessel. 4. As seen when laid open.

The instrument he recommends (Fig. 123) should be "tight-fitting enough to constrict thoroughly, and yet grooved and smooth enough *not to lacerate* the external coats, while it makes a *complete invagination* of the inner coats. For operating upon vessels in continuity, as for aneurism, I prefer to place the limb, after constriction, in a relaxed position, so as not to stretch the vessel after being constricted."

In Fig. 123 the instrument is shown applied to an artery, and in Fig. 123 (4) a section of the artery, subsequent to its constriction. I have tested this instrument on the living, and have made a large number of experiments on the dead, and find it does all that Dr. Speir asserts. I believe it to be of value for obstructing arteries in continuity, as it does for such precisely what torsion does for divided vessels.

Other Methods.

Astringents or styptics are also valuable agents in the arrest of bleeding, when the means previously mentioned are inapplicable, their value being much increased when combined with pressure. The perchloride or persulphate of iron, pounded matico, alum in powder or solution, applied to a bleeding surface on a pad of lint or dossil of cotton-wool, and bound on, are the best applications; though tannic acid, Ruspini's styptic, or oil of turpentine, are also serviceable. Before applying any of these, the bleeding part should be wiped as dry as possible, and all coagula removed. In uterine surgery, injections of some of these astringents are much used. In rectal surgery, the bowel may be plugged with lint or sponge saturated with a styptic, and in epistaxis the nose may be plugged with the same.

Cold is a powerful styptic, cold air often permanently arresting even copious hemorrhage on laying open a wound. A stream of cold water directed to a bleeding part, or ice pounded and placed in bladders or bags, and laid on bleeding wounds, are at times of great assistance.

Cauterization, although the common mode of arresting bleeding by the ancients, is now seldom employed; yet it is a valuable agent in cases where neither torsion, ligature, nor acupressure, is available. In spongy tissues from which blood is oozing, or even in other cases, the hot iron will often act most beneficially. It may be applied through iron buttons or cones brought to a *black heat* by means of fire, or through platinum or porcelain instruments, heated by means of gas or the galvanic battery. In both the heat should be enough to cause a dry eschar upon the bleeding part, while care should be exercised subsequently not to remove this too soon; indeed, the eschar or scab should be left for natural processes to throw off. The cautery in no case should be too hot, that is, *red hot*, as it destroys the vessels too much, but should be of a *black heat*.

Hemorrhage from the *capillaries* or small vessels, rarely takes place to any dangerous extent, unless it occurs in "bleeders," or such as labor under the hemorrhagic diathesis. It has always a tendency to stop by itself through the natural hæmostatic processes such as have been described. If, however, it be too persistent, the surface of the wound should be exposed and cleansed, the stimulus of the air being often sufficient to excite closure of the vessels. Moderate pressure upon the surface of the wound, or a stream of cold water over it are also valuable auxiliaries.

By way of summary, the following conclusions may be arrived at *for the treatment of hemorrhage from wounded vessels.*

All arteries, whether divided or wounded, from which blood flows, are, if possible, to be twisted or tied at the seat of injury; and to accomplish this, when room is required, the wound may be enlarged. *Both ends of a divided* artery are to be dealt with separately. When an artery is wounded John Hunter's advice is still sound, "First apply the tourniquet, then lay the artery sufficiently bare, and tie the vessel above and below the wounded part," MS. Lect. 1787. In some cases the vessel had better be completely divided and its two ends twisted. I have followed this practice with the brachial on three occasions, with good results, and advise its adoption on all arteries of less calibre

When no bleeding is present, no operation as a rule is required; although, in exceptional cases, this may be deviated from, as when a renewal of the hemorrhage endangers life.

When *moderate* arterial hemorrhage exists and the artery cannot be taken up in the wound without an operation, the graduated compress may be employed with a fair chance of success; but should it fail, the vessel must be secured.

When arterial hemorrhage endangers life and the artery cannot be treated at the wound, the trunk of the vessel is to be secured above the wound.

When *recurring* hemorrhage is severe, the wound is to be reopened or enlarged, all clots turned out, and the vessel tied or twisted. When moderate, it can be treated by elevating the part, by pressure over the main trunk of the vessel or the wound, and by the application of cold, such as the ice-bag.

At times all bleeding ceases on the mere exposure of the open wound; at others there is merely a general oozing. Under these circumstances, if exposure of the wound to the air, or to a stream of cold water fails to check it, well-applied pressure will often suffice. In exceptional cases styptics may be required.

Secondary hemorrhages are to be dealt with in the wound as primary, that is, when bleeding is profuse, the artery is to be re-ligatured or twisted at the bleeding point; when not severe, it will probably be restrained by pressure and the elevation of the part; as in a general way, when secondary hemorrhage takes place after the application of a ligature to a wounded artery, the bleeding comes from the lower end of the vessel. Guthrie has clearly shown, that repair is less perfect in the lower end of a divided vessel than in the upper, less contraction and retraction of the vessel, less perfect coagulation of blood, and effusion of plastic lymph.

Venous hemorrhage, unless from the trunks of large veins, quickly ceases, usually from the collapse of the veins. Where any impediment exists to the return of blood from the wounded part, it may prove, however, troublesome, yet its arrest will probably be secured on the removal of the obstruction. The elevation of the wounded part will tend much towards this end, as will also the application of cold, or firm pressure upon the spot.

When large veins are divided and the bleeding is copious, they must be tied or twisted. A small opening into a large trunk may be closed with a fine ligature, leaving the main canal free, as wounds of veins heal rapidly, such as after venesection.

Injuries of the large venous trunks, however, are of grave importance, and any wound or injury that induces, directly or indirectly, the complete arrest of the venous circulation through one of these, is probably of greater consequence than the wound of an artery. The internal jugular vein, too, may be tied with success.

A vein is known to be opened, when black blood flows from the wound in a steady stream and from its distal part, when pressure above the wound increases the flow and pressure below retards or stops it.

Phlebitis is the chief evil to be feared from an injury to a vein, and when it occurs, it is very fatal. Veins, however, will doubtless bear much more manipulation than our forefathers believed, without any such danger ensuing.

The entrance of air into a wounded vein is likewise a source of great danger; but the subject will receive attention in a succeeding chapter.

THE GENERAL TREATMENT OF HEMORRHAGE

is of importance, though subsidiary to the *local*. When *syncope* takes place as a result of loss of blood, the surgeon should not be too hasty in attempting to overcome it, as it is without doubt one of the most valuable means which Nature employs to check bleeding and to assist natural hæmostatics; but at the same time, great care is needed that the syncope be not fatal. If such an event appears imminent, the patient should be kept in the horizontal posture with the head low; cool air should be allowed to blow upon the face, or cold water sprinkled over it; some diffusible stimulant, such as ammonia, ether, chloroform, or the nitrite of amyl, may be inhaled, or brandy given in small quantities. In extreme cases some surgeons advise pressure being made upon the abdominal aorta or large arteries, to confine the blood to the nerve-centres; or, even transfusion may be employed. This operation, however, has never been in high favor with surgeons; from accoucheurs it has received considerable support, the late Dr. James Blundell having given it his energetic advocacy. When attempted it should not be delayed until too late or when the hope of rousing the nervous and circulating systems has become almost forlorn. Under all circumstances, plenty of bland liquid nourishment should be given, such as milk, eggs, broths, &c., and stimulants in moderation. When there is a prospect of recurring hemorrhage, all food should be given cold. In the convalescing stage, iron and quinine, ammonia, and bark, are of the greatest value. Opium is a drug that must not be forgotten, as in the restless stage of bloodlessness its action is most beneficial. It must, however, be administered with caution, for with a feeble heart large doses are apt to depress. Half-grain doses repeated at intervals are probably the safest; larger, however, may at times be given. When capillary bleeding takes place to any extent after an operation, a full dose of opium, say a grain, is often very valuable.

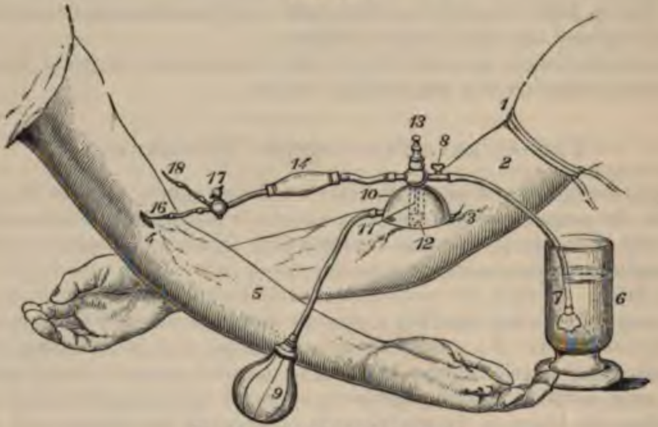
When the hemorrhagic diathesis exists, iron in full doses is of great service, the tincture of the acetate or perchloride in half-drachm doses being the best. Oil of turpentine is likewise a valuable remedy, twenty minim doses being sufficient for an adult. Gallic acid in ten-grain doses, and acetate of lead in one-grain doses, are also beneficial, and all these act upon the blood and dispose it to coagulate.

TRANSFUSION.

When Dr. Lower, of Oxford, with Sir E. King, in 1665, first practised transfusion, blood was drawn from an artery and conducted *directly* by means of a tube into the vein of the patient, the blood being propelled simply by the force of the circulation of the emitter. As time progressed, the inexpediency of opening an artery was felt, and the plan of transmitting blood from vein to vein came into use. In 1785 this plan was also warmly advocated by Dr. Harwood, of Cambridge. With this change of practice, the mode of operating had to be altered, because the force of the venous circulation was found to be insufficient to propel the blood. The *indirect* or *mediate* mode of operating consequently came into use, the blood of the emitter being received into a vessel and transmitted by a tube or syringe into the vein of the patient. To James Blundell is due undoubtedly the credit of having devised an apparatus by which the operation can be efficiently performed. He called it first an "impeller," and when improved, a "gravitater" ('Lancet,' 1829). Since his time Drs. Aveling, Hewitt,[1] Braxton Hicks,[2] and particularly Roussel, have done much towards rendering the practice more safe and certain. The object of the surgeon in the operation is, to transfuse blood from a healthy into a bloodless patient, and his aim should be to prevent the coagulation of the healthy blood during the operation, as well as to guard against the introduction of air into the veins. This operation should only be undertaken when a trustworthy apparatus is at hand, and of these Dr. Roussel's is without doubt the most complete. Aveling's, however, is excellent.

Dr. Roussel's instrument is made of hardened pure caoutchouc; it is composed of a tube with a Higginson's syringe large enough to contain two and a half drachms of fluid (Fig. 124) (14) in its course. One end of the tube is attached to a rigid cylinder (10), open at each end, and applied over the seat of the vein required to be punctured (3), which has been obstructed by the band (1). The cylinder is fixed in position in being surrounded by a rigid cup which can be exhausted by an elastic pump (9) in connection with it. The exhaustion of this cup not only fixes the apparatus to the arm, but also increases the turgidity of the vein over which it is applied. The cylinder within it (11) is then closed by the introduction at its upper extremity of a lancet (12), the exact depth of which can be regulated (13). Before operating, the air should be driven out of the cylinder and tube by filling them with tepid water (6), in which a little bicarbonate of soda may be dissolved, by means of the syringe (9), and the tube (8, and 7), which is attached to the cylinder opposite to the conducting tube (17). When about to operate the lancet (12) is depressed into the vein.

FIG. 124.



Dr. Roussel's injecting apparatus.

To the extremity of the conducting tube a stopcock (17) with two canulæ (16 and 18) is attached, the stopcock being inserted to direct the flow of fluid into one or other of the canulæ. One of these canulæ is introduced into the vein of the recipient (5). The apparatus (10) being filled with water, the vein is opened by the lancet and the contents of the cylinder and the tube pumped out through the free canula (18) until blood only flows through it. The stopcock (17) is then turned and the blood is injected into the patient's arm through an opening in the vein (4). The syringe by this apparatus "forcing the blood into the vein of the recipient by degrees as it draws it from the vein of the donor, every particle of it having remained less than a second out of the human vessel, inclosed in a full tube, and the blood conducted by an artificial vein and heart, hermetically closed, damp, warm, and soft as are the human vessels. The blood is not modified as regards its fibrine, globules, gas, temperature, or density; it passes from one system to another with all its primitive vitality, and continues to live on."

Not more than six to nine ounces of blood should be transfused at one time, the injection too should be gradual, that is, about six syringefuls a minute.

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[1] 'Obstet. Trans.,' 1865.

[2] 'Guy's Rep.,' 1868.

DISEASES OF THE ARTERIES.

Arteritis.—Under this heading, besides the rarer forms of disease, we shall include atheroma, as there is no longer any question of its inflammatory nature. Of this, Virchow, Billroth, Wilks, and Moxon, have given sufficient evidence, though in modern text-books the old view is still taught, and the weight of Gulliver's investigations ('Med.-Chir. Trans.,' vol. xxvi) has not yet lost its influence. We by no means think that Gulliver was altogether in error in holding that atheroma was a fatty and calcareous degeneration of the inner and middle arterial coats with subsequent thickening of the adventitia; on the contrary, it is not improbable that atheroma may sometimes be a simple retrograde metamorphosis of the arterial tissues; but, there can be no doubt that it more often begins as a sub-inflammatory process. This conclusion has been reached partly upon histological grounds and from the fact that the disease is most prone to occur where the wear and tear is greatest, and inflammation, consequently, most likely.

Arteritis is usually described as "acute" and "chronic," and it will be well for us to adopt the terms in general usage. But the student must remember that the pathologist applies the one to a process the product of which is cellular or nuclear; the other, to that which shows organized or tissue product, or some degenerative change such as the calcareous, which must necessarily have taken some time in its production. From a clinical point of view both terms are more arbitrary than exact, and there is other evidence than pathological to show, that changes, judged by such a standard to be chronic, are rapid in their course, and, in the same way others which must be called acute, in that microscopically they are cellular, are not necessarily of short duration. If we, then, continue to describe arteritis as acute and chronic, it is evident that no strictly histological basis is broad enough for accuracy, and we have therefore adopted that classification of acute arteritis which accords best with our own experience.

Acute arteritis is found under four conditions:—

1st. As slightly raised grayish or pellucid patches on the living membrane of the artery, which, when examined microscopically, show a multiplication of the cells of the superficial layers of the inner coat. It is a disease which is not, perhaps, of much importance when attacking the aorta or larger vessels, but when it affects the visceral arteries, it may lead to a considerable diminution of their calibre, to thrombosis, and thus to all those changes which ensue when the circulation becomes arrested. It is a change of this kind which Heubner lately described in the vessels of the brain as particularly liable to occur in the subjects of syphilis; and, it is possible, though not yet proved, that a similar result may be induced in the larger arteries from the same cause.

2d. As a general affection of the arch of the aorta, in which that vessel is grayish, softened, thinned, and dilated, but without any strictly atheromatous or calcareous change in it. It would be better perhaps to call this state acute softening, though the nature of the process is essentially inflammatory.

3d. As a local disease in the arch of the aorta in cases of acute rheumatism. This is rare, sometimes originating in the friction produced by large valvular vegetations which are washed backwards and forwards in the blood-stream, and sometimes without any such cause and apparently as a spontaneous arteritis. In either case, it is liable to lead to aneurism or imperfection of the aortic valves.

4th. As a local disease in the arteries, secondary to the lodgment of emboli, which, by their presence, set up an arteritis.

Chronic arteritis may occur as a widespread and continuous disease in most of the arteries of the body, or as one which is localized to various parts, specially the larger vessels. Of the former, a very rare disease, examples have been published by Wilks ('Guy's Rep.,' 1869), and Savory ('Med. Chir. Trans.,' 1856). The principal arteries of the body were thickened and obstructed, the vessels being filled with old clot that was "so closely adherent that the wall of the vessel would split rather than part from the clot. At both the ending and commencing parts the clot was white and like fibrous tissue, and could not be distinguished from the coats, which here were swollen and atheromatous. The atheroma, indeed, appeared to be here in the clot also as well as in the arterial coat" (Wilks).

There seems little doubt also as to the fact, that a vessel may become completely obstructed by a strictly local arteritis.

It may be noted in passing, that the descriptions of the naked eye appearances in these cases, exactly correspond with those of the so-called syphilitic disease of the cerebral arteries just alluded to as having been described by Heubner, and which has been classed by us as acute arteritis, inasmuch as it is a disease purely cellular.

Such cases as the last, however, are rare compared with those of local chronic arteritis, when met with in the arch of the aorta at its bifurcation and other parts. It is indicated by thickening of the vessel and loss of its elasticity, by the external coat changing into a ough fibrous tissue, and the affected parts, instead of feeling thin and pliable, becoming hard and leathery. "Now, such changes as these are commonly present along with the atheromatous pulp in the deep inner coat, and these are the part of the changes that go by the term atheroma as commonly accepted. Changes of a kind that cannot be regarded as other than inflammatory are present in nearly all bad examples of atheroma; the extent of the inflammatory changes generally surpasses that of the atheromatous, and these inflammatory changes occur often without any atheroma, and especially in younger subjects, about or under middle age. The more inflammatory changes tend more to produce aneurisms than do the atheromatous patches. When atheroma is thoroughly established, so that a pulpy mass is formed in the coats at any spot, this is generally thick and hard and unyielding, and does not give way to pressure so as to form an aneurism. The disease that leads to aneurism is the same disease as leads to atheroma, and I think it is a correct way of describing these relations to say that they are alternative results of the disease of the coats. I mean so that if the sub-inflammation is severer, then the coats are softened and yield early, before the thickening and stiffening chronic process that leads to the atheroma patch has time to occur. On the other hand, if the sub-inflammation is lower and slower, then there is not such softening at any time in its course as to lead to aneurismal yielding; but the result is a slow thickening, which reaches a considerable and a sufficient degree before any fatty degeneration occurs within it, and then always the thickening goes further than the granular change, so that the wall of the artery is rather stronger there than weaker; and if the sub-inflammation be yet slower and slower the fatty or granular change in the coat goes on to an accumulation of lime salts or petrifaction of the spot, the stone in the wall showing sometimes some rude bone-cells, so that ossification may be thought really to occur, though the bone is truly a very rough production, if it be bone at all. Now, if instead of being thus slow, so as to give time for the calcareous change of its products, the sub-inflammation be very acute, then the arterial wall may rupture, and either sudden death or a false aneurism be the result." "I might," adds Moxon, "give practically any number of cases and drawings, showing the active cell formation in cases of atheroma, this cell formation found in the deep layer of the inner coat especially, and causing the production of little nests of cells, in which fat and lime

Fig. 125.

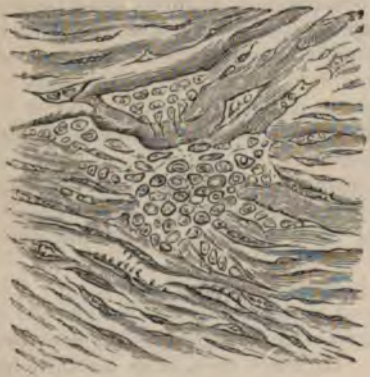


Fig. 125A.

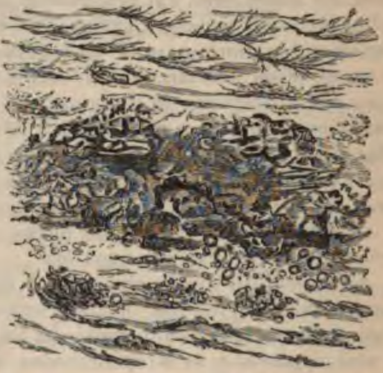


Fig. 125 shows the incipient inflammatory stage of the change in an artery which leads to atheroma, and in which aneurism usually occurs.

Fig. 125A shows the final degenerative stage of the same change in the artery which constitutes atheroma.

Fig. 125 is a small portion of a fine section of an artery from the neighborhood of an aneurism; the artery was here soft and swollen, and had a more pellucid and bluish appearance than natural. A small and early patch of the disease is represented. The cells of the artery-wall are found enlarged, their nuclei multiplied, and at the centre of the patch they burst towards each other to make a cluster of cells derived from the multiplied nuclei.

Fig. 125A is taken from the same artery at another spot, when the coat had the well-known yellow appearance of atheroma. Here the patch of multiplied cells has degenerated to a heap of oily and earthy matter with some plates of cholesterine. The individual cells around are seen to be degenerated in the same way. Some of those at the upper part of the figure are, on the other hand, developing into elastic fibrils. This is a frequent accompaniment of the atheromatous process, and its effect is to ultimately strengthen the arterial wall at the diseased spot.

soon accumulate. In severer cases the middle and outer coats, and the deep layer of the inner coat, are seen to be charged with lymph-cells in enormous numbers, crowded together, and separating the proper elastic and the muscular fibres into little patches and shreds, while both elastic and muscular fibres fall into a state of fatty degeneration."—Moxon, 'Guy's Hosp. Rep.,' 1870–71.

In Figs. 125 and 125A, taken from drawings kindly made for me by Dr. Moxon, these changes can be seen. His description is appended.

Dr. Moxon and others believe, and I think rightly, that mechanical strain is the main cause of atheroma of the arteries. It is chiefly found at points where the strain upon the coats is greatest and in men who follow laborious occupations. Gulliver originally described it as a disease of the larger arteries, but it is now known to involve the whole arterial system.

In advanced disease calcareous plates are found in the larger arteries, while the smaller are converted into completely solid tubes. The vessels, moreover, alter in shape, and become tuberous as well as tortuous—dilatation taking place at the points of bifurcation. When the disease is very extensive or advanced, the inner coats become destroyed and undermined with blood. When this takes place to any extent, what is known as a *dissecting aneurism* may be produced; but in other cases the inner coat is so raised by the clot of blood behind it that the arterial canal becomes closed, and gangrene of the parts supplied by the occluded vessel may ensue. In a preparation in Guy's Museum (1465), the aorta was thus affected, causing gangrene of the extremities. In others, the vessel may rupture, and cause death from hemorrhage. In rarer cases, the vessel may be completely closed by the calcareous disease, in some the roughened raised patches become the centres of fibrinous adhesions which may either cause occlusion of the vessel directly by their size, or, indirectly, by being carried into more distant arteries, as emboli. In both cases gangrene of the parts thus deprived of blood will be produced. *Senile gangrene* doubtless is occasionally caused in this manner. Thus it is seen that this atheromatous disease of the arteries is often the cause of gangrene of a part by direct occlusion of the vessel as well as by embolism. As a general rule, however, in those instances in which portions of artery are found to be withered and converted into fibrous cords, evidence is wanting of arteritis being the cause. Recent investigations tend to show too that such changes are the natural result of an obstruction of the vessel, and that this obstruction is probably due to a plugging of the canal by a clot, or to what is now known as an embolus.

Fatty degeneration of the inner, and a primary calcareous change in the *muscular* or middle coat of medium-sized vessels must also be mentioned. These may be and no doubt are mostly associated with chronic inflammatory changes in the arterial system, but there is also reason to believe that sometimes they are essentially primary degenerations which lead to contraction of the vessels and senile gangrene, as do atheromatous changes.

Embolism

is a somewhat common affection, and consists in the occlusion of a vessel, large or small, by a plug of fibrin or calcareous matter, carried by the blood from some distant part, and, generally, from the heart. The physician meets with it in cases of paralysis more or less complete, from the plugging of a cerebral vessel, associated with valvular disease of the heart, acute rheumatism, or aortic disease. The surgeon meets with it in certain forms of amaurosis and local gangrene, and, as a precursor of aneurism. The pathologist sees it in the fibrinous clots (infarcta) found frequently in the lungs, spleen, kidneys, or other organs.

The symptoms of embolic occlusion of an artery are, sudden and severe pain in the part from which the circulation is cut off, the pain in some cases extending down the whole course of the artery; in others it is a local numbness; whilst tenderness is usually present in the course of the vessel. Symptoms of a deficient circulation in the part soon appear, such as coldness and pallor of the skin, which may go on to complete gangrene. All cases of embolic occlusion of an artery, however, do not end in death of the part, since in patients of good power the collateral circulation may become subsequently established, and a recovery follow. In patients of feeble power gangrene is to be feared. In not a few cases, embolism leads to the formation of an aneurism.

A woman, æt. 47, who never had any illness, was seized in June, 1868, with a mild attack of hemiplegia on the left side, from which she perfectly recovered in three weeks. She remained well and returned to her ordinary duties, those of a laundress, for three months, when, whilst kneeling, she suddenly felt a severe pain in the *right* leg, extending down the calf. This was rapidly followed by numbness and coldness of the leg, and discoloration. She was admitted into Guy's under my care, three days subsequently, with gangrene of the foot and lower two-thirds of the leg. The pulsation in the femoral artery was normal, but no vessel could be felt below the thigh. I amputated the limb at the knee-joint on October 13th, twisting the popliteal and other arteries. Some sloughing of the stump followed, but recovery appeared probable, when acute bronchitis set in, followed by delirium and death. Dr. Fagge kindly examined this patient's heart before the operation and reported, "There is scarcely any evidence of cardiac disease, but I think that I discover a short presystolic bruit. If this is so the mitral orifice is probably contracted, and a clot formed on the valve, or in one of the heart's cavities, may have been carried into the artery of the lower limb." After death the mitral was found the size of a button-hole. Around its edge were recent vegetations, and one of them doubtless had been carried into the circulation, causing the gangrene, as another had caused the paralysis three months previously.

Many cases of senile gangrene are doubtless embolic, from the washing away of some calcareous fragment from an atheromatous vessel.

In some cases of occlusion of an artery by an embolus, after the application of a ligature, hyperæsthesia and increased temperature of the part below the seat of obstruction may be met with. These symptoms are clearly due to the influence of the nervous system and the congestion of the smaller collateral vessels.

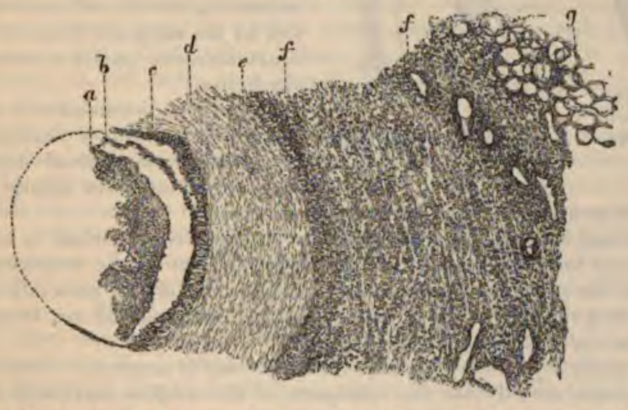
There remains to be considered, moreover, pulmonary embolism, a form which is important to the surgeon, not so much as a disease of the lung as because it is generally a sequence of some clotting or thrombosis as it is called, in the veins. This clotting is very common in all kinds of cases under treatment in surgical wards. We can hardly represent the case too strongly, and we know of no more important subject than this relation of thrombosis to pulmonary embolism. Whenever a patient undergoes prolonged rest in bed, especially if he be naturally weak, bloodless, or debilitated from any cause whatever; if the blood be over fibrinous as in lying-in women; whenever there is any surgical fever, and in other states too numerous to mention, there is a risk of clotting occurring in the *quiet* parts of the circulation, especially in the veins of the lower limbs and in those of the pelvis. The symptoms are often slight. If the clot be due to phlebitis, then there may be pain; if not, there may be no more than the slightest œdema about one ankle. This, however, is sufficient to put the surgeon on his guard, and, by the subsequent enforcement of prolonged rest, time is given for the adhesion of the plug to the vein wall, and pulmonary embolism is arrested. It should be remembered, too, that clot forming in contact with a comparatively healthy vein wall, as is the case in many instances, takes time, and sometimes a very long time, before adhering to the wall, and until it does there is the risk of its detachment when the patient moves. There can be no doubt that many have died of pulmonary embolism, when with a little more vigilance on the part of the attendants, the patient might have been saved.

These remarks apply to embolism of the larger branches of the pulmonary arteries, which never give rise to further changes in the lungs, and the patient dies from asphyxia. If the smaller branches, however, become plugged, then arise those secondary infarcta already mentioned, and, in the case of septic embolism, lobular pneumonia of pyæmia and gangrene of the lung.

Dr. Wilks has also shown ('Guy's Hosp. Rep.,' 1870) that, as in phlebitis, morbid matters may be taken up by a vein and carried into the circulation through the right side of the heart, thereby giving rise to *venous pyæmia*, so disintegrated fibrin of the blood may be carried into the arterial system from the left side of the heart, and give rise to *arterial pyæmia*. Febrile symptoms with joint-pains and rigors, associated with aortic and mitral bruit, ought to excite suspicion of this latter affection; but when the liver or spleen is found enlarged, the diagnosis is confirmed. He also points out how this occurs as a secondary fever of the nature of pyæmia, after scarlatina, which is often followed by joint-pains, and not unfrequently by endocarditis. In confirmation of these views I may mention that it has fallen twice to my lot, in the case of female patients, aged respectively fifteen and twenty years, to amputate a leg for gangrene, the result of occluded femoral artery after scarlet fever. In neither of these cases had any vessel to be secured, while in both a good result rapidly ensued.

Pathology.—The changes which take place when an artery becomes plugged, differ according to the size of the affected vessel. If it be a *terminal* vessel, the immediate result is congestion of the vascular area concerned, with subsequent hemorrhage and atrophy of the tissue. The various stages may be studied with great precision by the ophthalmoscope in occasional cases of embolism of the arteria centralis retinæ. It is unnecessary to discuss whether the process is due to vasomotor paralysis or alteration of blood pressure, since it is of pathological rather than of surgical interest, and the questions involved are fully stated in all pathological works. We shall, therefore, only remark further that embolism of the small vessels is important or otherwise, according as the source from whence the plug is derived is healthy or not. If the clot be septic, then the resulting infection will probably lead to an abscess, and hence the probable connection of abscesses in the pelvis with those in other parts after labor, or after operations in the viscera or connective tissue of the body. But embolism of the medium size and larger arteries is followed by changes of the very greatest moment in the walls of the affected vessels. Unfortunately they have, up to the present time, not been fully worked out as regards embolism, though we can obtain considerable aid towards understanding what takes place by availing ourselves of the experiments which have been made for us by the ligature of vessels. When an artery of any size becomes closed by an embolism, the canal may of course be gradually restored by the disintegration and washing away of the plug; if not, the presence of the clot acts as an irritant, inflammation is set up, and the clot becomes adherent to the wall of the vessel. It is a disputed point whether the next stage is one of organization and vascularization of the clot, or of absorption of the clot by vascular granulations which spring up from the wall of the vessel. Weber holds the former, but Cornil and Ranvier the latter view. This difference, however, does not matter, as all that is important would be granted by either, viz., that embolism leads sooner or later to a local inflammation of the arterial walls. But if arteritis is thus produced by a simple and healthy clot, the intensity of the local disease will vary as the plug is healthy or septic, and, it is surely not too much to suppose, that some plugs will so excite the component elements of the surrounding arterial coat that its tissues will become disorganized, its cellular elements multiply rapidly, and the coats as a consequence give way. Indeed, we know that these changes do actually occur in small vessels, and abscesses follow; so without doubt, also, though the fact is less generally recognized, the same changes occur in the larger arteries and lead occasionally to aneurism. I shall revert to this subject in the chapter on aneurism, and will add no more here, since what has been already said, together with the subjoined wood-cut of the state of the arterial coats after embolism, may sufficiently explain the morbid processes set up in the larger vessels.

Fig. 126.



Transverse section of the upper part of the radial artery plugged by an embolus of septic origin some days before death. From a case of ulcerative endocarditis (boy, æt. 19). Drawn by Dr. J. F. Goodhart, to show the condition of the adventitia.

a. Clot.
b. Internal coat.
c. Internal elastic or fenestrated membrane.
d. Middle muscular coat.
e. Outer elastic membrane.
f. Adventitia crowded with abnormal nuclei, and proportionately thickened.
f'. Region of vasa vasorum.
g. Fat.

TREATMENT.—The objects which surgeons should have in view in the treatment of a vessel occluded by an embolus are, to favor the venous circulation through the limb by its elevation, and to establish the arterial collateral circulation by maintaining the warmth of the limb by means of cotton wool carefully wrapped round it over oiled lint. Pain may be relieved by sedatives, such as chloral or opium given by the mouth, or morphia injected subcutaneously, while the powers of the patient are to be maintained by nutritious diet, by stimulants carefully administered, and by tonics.

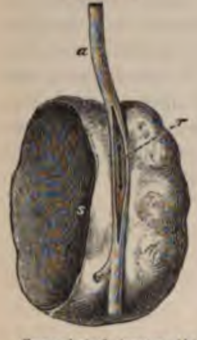
When gangrene has taken place, the parts may be covered with some antiseptic material, as carbolic acid in a watery or oily solution, one part to thirty; or with powdered charcoal, chloralum, terebene, or MacDougal's disinfecting powder; but if the odor is not very offensive, simple oakum surrounding the part may be sufficient.

When the line of demarcation has formed, and the gangrenous part can be removed by amputation, such an operation may be performed, but the surgeon should always be cautious in interfering with these cases. He should at the same time take every precaution that any necessary or desirable operation is not unduly postponed.

ANEURISM.

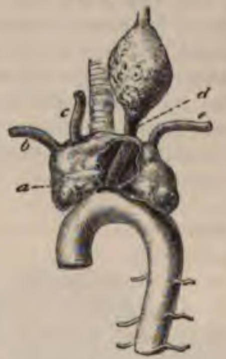
An aneurism is a fusiform dilatation of, or a *sacculated tumor* communicating with, the canal of an artery, and is formed more or less from its walls. When all the coats are involved in the sacculated dilatation, it has been the custom to describe it as being *true*; but as *false* when the two inner coats have given way and the external or cellular alone remains. I agree with Holmes, that it is impossible clinically to perceive any difference between true and false aneurisms at the time they generally come under observation, inasmuch as the true become false as they grow, and the false are by far the more common. I hold, moreover, with Moxon, that pathologically, "when an aneurism has reached any size, and often before it has well started, the several coats of the vessel have lost by inflammation their distinctive character, and that the sooner the division of aneurisms into varieties by the supposed behavior of the several coats becomes purely a matter of history the better."

FIG. 127.



Sacculated traumatic aneurism. Drawing 44^{18}, Guy's Hosp. Mus. Mr. Poland's case.

FIG. 128.



Drawing 42^{80}. Guy's Hosp. Mus.

When the distension of a vessel involves its whole calibre, a *fusiform or tubular aneurism* or aneurismal dilatation is said to exist, whether the enlargement be or be not due to an inflammatory disease of the arterial coats.

What is described as a *diffused, spurious, or consecutive* aneurism is where the sac of the aneurism is not formed by any of the arterial coats, but by the muscles and condensed cellular tissue of the part into which the extravasated blood has been effused from a ruptured aneurism or a ruptured artery; although these terms should not be applied to cases in which there is *diffused extravasation* of blood.

A dissecting aneurism is one in which the inner coat is separated from the middle, or, where blood is extravasated into the thickness of the middle coat itself or between the middle and external coats, the blood re-entering the cavity of the artery at some distant spot. The aorta is the part usually affected, and even its whole length may be involved. An excellent example of this affection has been recorded by Dr. Fagge ('Med.-Chir. Trans.,' vol. lii). These cases, however, rarely come under the hands of the surgeon. To show what an aneurism may do, the above figure (Fig. 128) is given. It was taken from a drawing in Guy's Hospital Museum. The aneurism of the innominata has involved the left carotid and root of the subclavian, a second aneurism of the left carotid existing above.

PATHOLOGY OF ANEURISM.

A low form of inflammation of the arterial walls is without doubt the most common predisposing cause, while overaction of the heart and circulation is the exciting cause of aneurism. Direct injury to an artery is an occasional cause (traumatic), although more frequently the injury sets up the disease in the artery that produces the aneurism. Whenever the coats of an artery are weakened by accident, disease (suppurative or otherwise), or the loss of their natural support, they become liable to dilate under any sudden or prolonged increase in the force of the circulation under violent exertion, or from a sudden emotion of the mind. Dr. Rendle, of the Queen's Prison, Brixton, has recorded two cases in which abdominal aneurism could be traced to the shock caused by a sentence of transportation. Hence aneurisms are more common in the aorta, where chronic inflammatory changes are so likely to appear, and the heart's action more directly felt; at the bifurcation of an artery, where the force of the circulation is always more powerful; or, at the flexure of joints, where muscular action is the most liable to tell by overstretching or bending.

That aneurism is a disease of the arterial system and not always of traumatic origin is proved from the fact that a man may have an aneurism form when in bed, and that the whole arterial system may be involved in the disease. Broca has mentioned a case of Pelletan's, in which sixty-three aneurisms were found in one body. It is also a disease of middle age, half the cases, according to Lisfranc, occurring between the ages of thirty and forty-five. It is not uncommon, however, to find it in young persons. Syme has recorded an instance in a child of nine. My colleague, Dr. Habershon, had another of femoral aneurism with heart disease in a boy of ten, and *cerebral* aneurism in early life is still more common. But such cases, almost without exception, are associated with extensive vegetations on the valves of the heart often with ulceration of the valves. The symptoms are those which Dr. Wilks has described under the term "arterial pyæmia," or mainly, considerable pyrexia and enlargement of the spleen. Many such are now on record, and, beside the parts above mentioned, they have been found situated on the ulnar, popliteal, axillary, mesenteric, and many other smaller vessels. Indeed the frequency of their occurrence can only be estimated by looking into the literature of visceral aneurisms. It will then be found, that though the relation between heart disease and aneurism has not till of late years been studied (and even now only an opinion is doubtfully hazarded as to the connection between the two) very many cases of aneurism associated with endocarditis and emboli in the solid viscera have been recorded at different times. Among the earliest writers on the subject are Joliffe Tufnell in the 'Dublin Journal,' vol. xv, p. 371; Dr. Ogle, 'Path. Trans.,' vol. viii; Dr. Wilks, do., vol. xi; Mr. Holmes, do., vol. xii. Other cases have been recorded in the same 'Transactions' more recently by Drs. Church, Goodhart, Gowers, Murchison, Semple, and myself. Similar cases may also be found in various medical publications, *vide* Bright's 'Medical Reports,' vol. ii, p. 266; Gull, 'Guy's Hosp. Rep.;' 3d series, vol. v, p. 299; Ponfick, 'Virch. Archives,' Bd. 58, 1873. See also Wilks and Moxon, 'Path. Anat.,' p. 158–9; Holmes, 'Syst. Surg.,' &c.

Various explanations have been given of the occurrence of aneurism under such conditions. It has been maintained by some that the plug leads to sudden obstruction and afterwards to dilatation of the vessel behind it. But a look at preparations of such aneurisms shows, that the dilatation is not behind the embolus, but actually at the plugged spot. Moreover, if the local obstruction leads to dilatation behind it, we ought to find aneurism a more common result of ligature than is the fact; we ought to find it more frequently after embolism than we do, because embolism is a very common affection in one part or another of the body. Other ingenious, though somewhat labored, explanations have been offered, which need not be mentioned here, and the only one of any importance is that recently ably argued by Dr. Goodhart, attributing the aneurism to a local arteritis, which in its turn has been caused by the embolism. It has been already asserted that when an artery becomes blocked, the clot, unless it softens and breaks down, becomes adherent to the wall, and subsequently the lumen of the vessels is traversed by vascular tissue. If this is true, and that it is, is allowed by nearly all observers, then there must have been some preceding inflammation of the wall of the vessel to allow of this new formation of capillaries. It is no new fact, therefore, that embolism causes a local arteritis, since it follows from what has already been determined. We have only to explain how it is that when embolism causes a local inflammation of arteries in all cases, an aneurism is so rare a result. The explanation is to be found in an examination of the cases in which these are found. They are almost without exception examples of ulcerative endocarditis—a very severe inflammation locally, and attended usually with symptoms of blood poisoning, supposed, and we think rightly so, to be due to the septic nature of the emboli which are detached from the ulcer and carried to all parts of the body. Now, what must happen if such a clot becomes lodged in some part of an artery? In proportion to the severity, or as we should say surgically, in proportion to the foulness of the ulceration, so will be the intensity of inflammation round the embolism; in the more severe cases the rapid formation of an abscess and perhaps a false aneurism; in those somewhat less severe, acute

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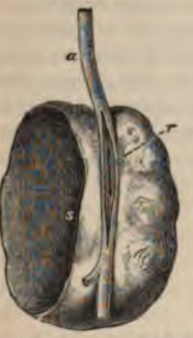
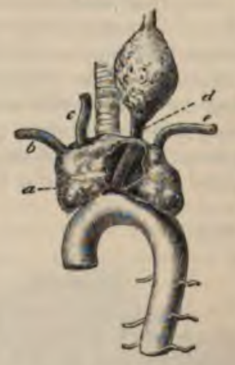


Sacculated traumatic aneurism. Drawing 44¹⁶, Guy's Hosp. Mus. Mr. Poland's case.

Fig. 128.



Drawing 42⁶⁰. Guy's Hosp. Mus.

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d. Scarcely laminated clot, filling the hollow of the sac.

The vein, with two valves in its lower part is seen close behind the artery.

nearly two years before by digital pressure. The
nbedded in the popliteal fat, *e*, *e*.

nd even absorbed; bone may even be gradu-
pulsating tumor, so that in thoracic aneurism
ies of the vertebræ eaten away, and the spinal
Mus.). During this increase the tissues also
gh they rarely suppurate, and, by becoming con-
rt and tend to retard its growth. In rare cases this
itself and cause sloughing; but when the aneurism
ly give way. A thoracic or abdominal aneurism may
e trachea, pharynx, œsophagus, or intestine, and, when
. Trans.,' vol. xlii) has shown that it proves fatal by a
small orifice. When it bursts into a serous cavity, such
eritoneum, it destroys by a sudden hemorrhage through a
on record where it discharged itself into a vein or the pul-
urgical aneurisms burst by the formation and giving way of
xtremities or surgical aneurism may give way into a joint or
st externally only in rare instances.
has more to do with external than internal aneurisms, and
of both forms is alike, the treatment differs. It is to surgical
at the following remarks may specially apply, and first of all as to
agnosis.

SYMPTOMS AND DIAGNOSIS.

s no pathognomonic symptoms, and its early symptoms are very uncer-
happens that the patient's attention is first directed to some *swelling;*
be only that of *local throbbing*—some weakness or stiffness of an extremity
e *pain* preceding the discovery of the disease; yet such symptoms are not
hen, however, the surgeon is consulted for pain that shoots down the course
nning in contact with a large artery, he should allow the thought of aneurismal
pass through his mind, and, when this is associated with the presence of a
nected with the vessel, the suspicion of its being aneurismal should be excited.

If this tumor be *soft* and *pulsating*, and become tense on the application of pressure to the trunk of the artery on the distal side, and flaccid, non-pulsatile, and vanishing on pressure on the cardiac side, and, should pressure on the tumor modify the pulse in the vessel below, the chances of its being aneurismal amount almost to certainty. Should it expand again readily on the removal of the pressure, and this expansion be accompanied with a peculiar thrill on the re-admission of blood into the sac, with a bellows murmur or aneurismal bruit, synchronous with the pulse, audible too on the application of the ear to the tumor, the diagnosis is complete.

The pulse of the extremity below the swelling is generally affected, which becomes weaker and slower than its fellow, and, as the disease progresses, it may cease altogether. The blood will then flow in a " venous stream" or cease to flow either from the obstruction of the arterial trunk by the pressure of the aneurism, or the embolic occlusion of the vessel below from a dislodged coagulum. Under these circumstances, fulness of the veins with œdema of the parts supplied by the artery will soon appear, and, at times, excruciating pain from stretching of the nerves will arise. If the aneurism be cervical and the circulation through the brain be interfered with, giddiness and loss of consciousness may be present, and where any pressure is made upon the recurrent laryngeal nerve, a peculiar and characteristic hoarseness will be produced. This hoarseness is sometimes associated with loss of voice and laryngeal spasms simulating laryngeal disease. In the case of a woman, æt. 22, under my care, in whom an aneurism existed involving the aorta below the opening of the left subclavian and pressing upon the left bronchus and trachea, this symptom was so severe as to call for tracheotomy. When the cervical sympathetic ganglia are pressed upon, the pupil of the affected side may be permanently contracted, and nerve pains will be present according to the amount of pressure applied.

When an aneurism has partially consolidated, and has either so enlarged or become so diffused as to press upon the soft parts so as no longer to exhibit any pulsation; when it feels firm, with possibly a soft point here and there, some difficulty may be felt in forming a diagnosis, and the surgeon, under these circumstances, will have to depend as much upon the history of the case as upon the physical symptoms. When external signs of inflammation or suppuration are present, the difficulty will be enhanced, for it must be recorded, that aneurisms under these circumstances have been opened for abscesses. I remember a popliteal aneurism having been so maltreated with a fatal result. Such mistakes of diagnosis, however, ought not to occur, as they are due to carelessness. The diagnosis of an aneurism may generally be made by attending to the history of the case and to the existing symptoms. An abscess in contact with an artery may receive pulsation from it, as may any cyst or even solid tumor, but in all these the pulsation will cease on the application of pressure to the artery above the tumor, without any change whatever taking place in the tumor itself. I have seen a case of lumbar abscess which pulsated freely from aortic contact. It is also rare for such tumors to cause a bruit. Occasionally cases are on record in which an artery in contact with an abscess or suppurating hydatid cyst was opened by ulceration, and gave rise to the idea of an aneurism. Pulsatile tumors of bone may also be mistaken for aneurism; but the fact that they are in bone and more or less ossific, that the bone is expanded, although perhaps irregularly, and that a bruit rarely exists, ought to prevent error. It must be admitted, notwithstanding, that men of the greatest skill and experience have mistaken such cases for aneurism.

TREATMENT.

There is probably no disease a surgeon has to treat requiring to be dealt with more on scientific principles than aneurism, as all treatment to be effective must be based upon the physiological processes of a natural one, and he will be successful in proportion as he is able to use those processes and to turn them to account. It has been already explained, that spontaneous cure of an aneurism is commonly caused by the coagulation of the blood in the sac; and, as a consequence, it ought to be an aim to encourage this result in every way, which is to be sought by general as well as by local means. To induce coagulation of blood in the sac by natural processes, it is necessary to have a feeble circulation through it; for this purpose, *rest in the recumbent position is an essential point of practice*, and it ought to be maintained in every case; indeed, there is every reason to believe, that by it alone, aneurisms have been cured. Luke ('Lond. Med. Gaz.,' May, 1845), Bellingham, Tufnell, and others, have recorded instances of this nature, Tufnell allowing for diet about ten ounces of solid and eight ounces of fluid food in the twenty-four hours. *As a preliminary to all other treatment absolute rest is, therefore, most essential.*

With the same object bleeding has been employed, and was at one time largely practised on the authority of Valsalva, who powerfully advocated it, and probably to excess. There seems no reason why it should not be adopted when the force of the circulation is too strong and the powers of the patient are good; as bleeding under these circumstances is not only rational but scientific; it lowers the force of the circulation, while at the same time it has a tendency to render the blood more fibrinous. In internal aneurism it is calculated to be of more service than in external, but practised with caution, it is doubtless of value in both. Medicines do not seem to have much influence in encouraging the coagulating process, though the acetate of lead gave some promise of value in the hands of my former colleague, Dr. G. O. Rees, but more extended experience has not confirmed the hope. In external aneurisms, its employment to the sacrifice of local means does not seem justifiable, but in internal cases it may still be used. When syphilis is suspected as a cause, the iodide of potassium or sodium should be employed. *Nutritious* but *unstimulating* food should be given in all instances to maintain the powers of the patient, though not to increase the force of the circulation. All mental excitement should be positively forbidden.

The local treatment of aneurism is based on similar principles, the aim being to diminish the circulation through the sac. The success, however, which may be expected from the practice adopted will depend much upon the shape of the aneurism, as well as the size and position of the opening into the sac. This may be effected by the following means, viz.: *by compression in one of its forms* of the artery above the aneurism—*indirect;* by *compression of the aneurism itself—direct;* by the *Hunterian operation, i. e.*, the application of a ligature to the artery on its cardiac side; by imitating the rare natural process of closure of the artery on its distal side by the application of a ligature, or by pressure, or by the artificial production of an embolic plug by Fergusson's method of *manipulation;* and last of all, it may be laid open and both ends tied (Syme's operation), after the ancient method of Antyllus. The treatment by electro-puncture, injection, and the introduction of some foreign body into the sac may be adopted in exceptional cases.

COMPRESSION.

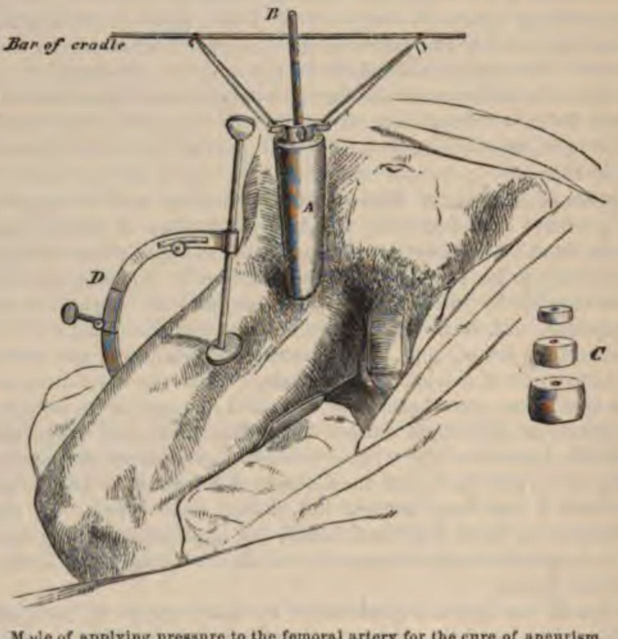
This plan of treatment, to which the term of "Dublin Method" may be fairly given, has now found a lasting place in surgery; as Todd, Hutton, Bellingham, Tufnell, and Carte, though not originating the practice, have adduced ample evidence of its scientific and practical value. It consists essentially in the more or less complete cutting off of the supply of blood from the aneurismal sac by the application of pressure to the artery on its cardiac side, and the more completely the current of the blood is arrested, the more rapid appears to be the cure, modern experience fairly proving the soundness of Dr. W. Murray's observation that the principle on which the rapid method rests is clearly "the complete stagnation of a mass of blood in the aneurism until it coagulates." For this purpose digital pressure is undoubtedly the best; but when it cannot be made available, mechanical means must be employed, and the nearer it approaches to digital pressure, the more it is undoubtedly to be preferred. The practice is theoretically sound and practically safe, and is capable by itself of curing the majority of surgical aneurisms, and even some that are internal. If, however, it does not succeed in curing every case in which it is employed, it doubtless helps, both by promoting coagulation of the blood in the sac, and by producing enlargement of the collateral vessels. When the rapid treatment is employed, the administration of some anæsthetic may be called for, and as its influence is required to be kept up for hours, an additional danger to the treatment has to be taken into account. In other respects the success of the "rapid pressure" treatment has been satisfactory, Mr. Holmes recording in his lecture before the College of Surgeons in 1874, that out of twenty-three cases in which it has been carried out, fifteen were cured. In those, however, in which rapid pressure has been used and failed, the application of the ligature has never succeeded. It is applicable only in cases in which the more usual forms of practice are inapplicable or have failed.

Compression should not be attempted where evidence exists of pressure upon the main vein of the limb, as indicated by œdema; or, where the aneurism is rapidly increasing, or a rupture of the aneurism appears imminent, because in such case a ligature should be applied to the arterial trunk. It should not be persevered with when sloughing of the skin has been induced; nor ought it, when, from some constitutional irritability, indocility, or stupidity, the patient fails to second the surgeon's aim; for to make the patient understand the objects which the surgeon has in view is doubtless a valuable means of guaranteeing their successful accomplishment. At least, four cases of aneurism of the neck have been cured by digital compression of the common carotid, and M. Rouge, of Lausanne, reports another in which a man, æt. 68, had a carotid aneurism cured in seventeen days by lateral pressure between the thumb in front of the sterno-mastoid muscle and the fingers behind ('Bull. de la Soc. de Chir.,' 1868, p. 464). Mr. Gay has also apparently cured a carotid aneurism by the same process ('Lancet,' Holmes's Lect. 1873).

Digital pressure in order to be successful must be well applied; when indifferently carried out, it is probably less to be relied upon than instrumental pressure. To keep up a steady pressure upon the trunk of any artery for any time consecutively, is a difficult task; and few men could do it more than ten minutes. What is wanted is the steady equal pressure of a finger or thumb applied directly over the vessel which is to be compressed, such pressure being so adjusted as to be sufficient to arrest the flow of blood through the artery, but no more. Greater pressure than this is a waste of power on the part of the surgeon, and a cause of needless distress to the patient. Neither vein nor nerve need be much pressed upon as a rule, nor much pain produced. To carry out this treatment three good men should be employed for four or five hours consecutively, each in rotation carefully applying pressure for ten minutes at a time. By adopting this practice I have cured an aneurism of the thigh in twenty-four hours, and in other cases even less time has sufficed. In a case I recorded in 'Guy's Hosp. Rep.' for 1869, a patient æt. 32 cured himself of a popliteal aneurism by pressure in four and a half hours. In one more recent a man æt. 40 cured himself in eighteen hours, after flexion and prolonged surgical treatment by instrumental pressure had utterly failed. M. Vanzetti, in 1855, records another in which digital compression cured a popliteal aneurism in four hours.

When digital pressure can be employed and is successful, it is more rapid than any other, and as a rule less painful. It can also be used where instrumental pressure is inapplicable, as in the case of the carotid. In fact, when admissible, it should always be primarily employed in preference to any other form of treatment. *When digital compression cannot be applied, the next best is instrumental pressure,* and for this purpose there is nothing equal to a conical weight of lead (Fig. 131 A) covered with leather and perforated with an iron axle (B), upon which extra pieces of lead (C) can be dropped (Bellingham's Method); the weights being so adjusted as to arrest the circulation through the artery and no more. This weight can be slung to a cradle placed over the limb, held

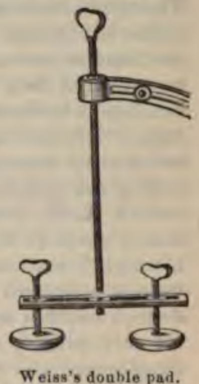
FIG. 131.



Mode of applying pressure to the femoral artery for the cure of aneurism.

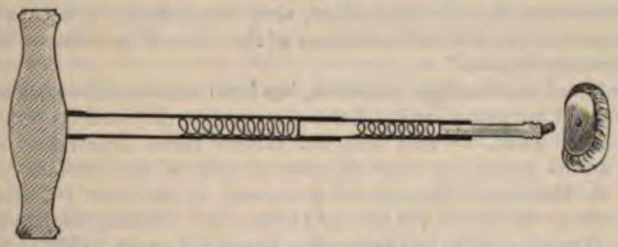
by an assistant, or left to the intelligent patient. It can be shifted gently from one spot to another when pressure causes pain, and is far less painful than any other instrument. In popliteal aneurism, the weight may be adjusted to the upper part of the groin, and it is an excellent plan to apply a semicircular tourniquet lower down, by which means pressure can be applied alternately. The instruments of Signorini, Bellingham (Fig. 131 D), Skey, Crampton, Carte, or any other that allows the pad to press upon the vessel, and not otherwise interfere with the circulation through the limb, may be used for this purpose. All of these consist of a circle or semicircle of steel, a fixed pad being attached on one side for counter-pressure, and a movable pad, adjusted by a screw, for direct pressure. Indeed, with these instruments carefully adjusted by the aid of a trustworthy assistant who will see that pressure is well applied, maintained, and shifted only when required, most cases of aneurism of an extremity may be treated. In Fig. 132 is depicted an ingenious contrivance made by Weiss, on the principle suggested by Mr. F. Bulley, for the application of pressure to an artery by means of pads which may be used alternately, and adapted to Bellingham's instrument (D, Fig. 131), either by the rigid screw or elastic pressure of Coles's pad; and in Fig. 133 a very valuable one as suggested by Mr. George C. Coles—the pressure being elastic—that may be used as hand pressure or adapted to any of the tourniquets. The treatment by compression requires intelligent supervision, and with this is very successful; but without it is uncertain in its effects.

Fig. 132.



Weiss's double pad.

Fig. 133.



This instrument consists of a trephine handle, to which is attached a straight rod telescopically arranged. The two upper segments of this rod are hollow tubes, each containing a spiral spring; the lower segment is a solid brass rod fitting into the upper, having at its extremity a screw at an obtuse angle. To the end of this a pad, composed of cotton-wool and horsehair, is adjusted.

My friend and colleague, Mr. Davies Colley, who happened to have been my dresser when a case of popliteal aneurism was under treatment by digital compression, informed me, that he proved by experiment, that he could readily arrest the circulation through the femoral artery for six or eight hours at a time with his finger applied directly over the vessel, and the weight adjusted upon his finger—the weight acting in lieu of muscular power that would have been required as the compressing force.

To neutralize the effects of the local irritation of the skin by the pressure, free use may be made of French chalk, starch, or violet powder. To allay pain, opiates, or hypnotics, as chloral in full doses, may be given, and in some cases even chloroform may be used and its influence kept up for several hours, to allow of complete compression being maintained. Dr. Mapother did this for twelve hours. There seems little doubt that in a general way, complete obstruction to the circulation is more likely to be followed by a rapid cure than is incomplete, and that next to completely stopping the flow of blood till the aneurism has consolidated, the application of the intermittent complete compressing force is to be advocated, or, in other words, complete compression may be maintained for a certain time, and then given up to be returned to as soon as the condition of the patient will permit. The total suppression of the circulation is doubtless the most rapid plan of curing an aneurism; but the partial suppression is likewise successful although slower. On all these points, however, I should like the Dublin surgeons to speak. Dr. Rawdon Macnamara has done so in an able paper ('Brit. Med. Journ.,' Aug. 19, 1871), from which the following extract has been taken. It epitomizes the whole:

"A case of popliteal aneurism presents itself for treatment. We determine to use compression. We first carefully ascertain the condition of the patient's general health. If anæmic or hyperæmic, we take appropriate measures; and, when we are satisfied upon this point, we apply some one or other of the most improved compressors—those in which the compressing power is modified elasticity. With this we compress the artery in the upper portion of its course, having previously arranged, some three or four inches lower down, the auxiliary instrument by means of which we propose to alternate the pressure. The upper instrument is now made to control the artery, so as but just to arrest the pulsation in the sac. This is the most delicate step in all the procedure, and is regulated by the hand of an intelligent assistant, who at once informs us when the pulsation is arrested; and then and there the further application of pressure is arrested. A roster of intelligent students is now organized, and to them is entrusted the management of the case. Two are appointed to take charge of the patient for one hour, when they are relieved by two others, and so on during the day, whereby we secure unwearied attention during the period that pressure is kept up; and, as in Dublin we visit our hospital at nine o'clock A. M. the treatment generally commences about that hour, and is continued up to nine o'clock P. M., when all pressure is removed, and the patient is encouraged to take his night's rest undisturbed. Next morning the treatment is resumed, and so on until the cure is perfected. At the commencement of the case, we take the patient into our confidence; explain to him the nature of his case and the method we are about to adopt for his cure, placing clearly before him the alternative, with all its possible dangers, which we should have to adopt in case compression should fail. The value of this procedure is very frequently demonstrated by the intelligent interest exhibited by our patients in the management of their own cases, so intelligent as in protracted cases to supplement, if not altogether to supersede, the supervision of them by our students. In the selection of our compressing force, we adopt in its widest sense the maxim 'Nullius addictus jurare in verba magistri.' Should one compressor prove irksome, we try another; if all should fail, we have recourse to digital compression, or to compression by means of weights; but in every instance, convinced of the soundness of this plan of treatment, we leave no stone unturned to secure its success."

Since Esmarch's elastic bandage, however, has been introduced, surgeons have employed it in the treatment of aneurism, and, where success has followed its use, the results have been very striking. Thus, we find that Dr. Walter Reid, R. N., who first adopted the practice, cured by its means, in fifty minutes, a case of popliteal aneurism ('Lancet,' 1875); Mr. F. A. Heath, of Manchester, a second, in an hour ('Lancet,' 1876); Mr. Wagstaffe, a third, in two hours ('Lancet,' 1876); Mr. Thomas Smith, a fourth, in three hours; and Mr. Wright, a fifth, in twenty-four hours ('Lancet,' 1877). Mr. Bradley has had, however, one unsuccessful example, Mr. T. Smith two, and I now record a fourth, in which I am disposed to think the practice not only failed to cure but did harm.

The case was that of a man, æt. 45, who was admitted into Guy's, under my care, in March, 1877, with a popliteal aneurism, which was increasing so rapidly that active treatment was called for. The man could bear neither digital nor instrumental pressure upon the afferent artery. I consequently applied the elastic bandage to the limb below the aneurism, using moderate pressure, allowed the aneurism to fill with blood, and then so compressed the thigh above the sac as to entirely check all pulsation in it, these three being apparently the essential points to observe. A subcutaneous injection of morphia was also given. The pressure was maintained for three hours consecutively and a second dose of morphia injected, but when the bandage was removed the aneurism was decidedly harder, although pulsation still existed in it. Four days later all clot seemed to have disappeared, and as the aneurism was as big as ever, the elastic bandage was again applied, only on this occasion, to soothe the man, an anæsthetic was used. This treatment was continued on this occasion for three hours, and at the end, little had been gained from it. A fortnight was then allowed to elapse to allow the parts thoroughly to recover themselves, when a carbolized catgut ligature was applied to the artery, and within one week this wound had completely healed by immediate union, not a drop of pus having been exuded, indeed, the patient had no idea that any operation had been performed upon his thigh.

The foot, however, soon became the seat of anæmic gangrene, and a fortnight after the application of the ligature, was amputated in the middle of the leg, and a good recovery followed.

In this case I am disposed to attribute the gangrene to the employment of the elastic bandage, and fear that from its two applications many of the small arterial branches that would have carried on the circulation through the foot, after the ligature of the femoral had become blocked, and that, as a consequence gangrene followed. The case indeed tends much to support the view, which Holmes [illegible] monstrated in his college lectures, that where pressure fails to effect a cure in the treatment of an aneurism, the success of ligature of the vessel is not so good.

An aneurism is known to be cured when it has consolidated and lost all pulsation, and the anastomosing arterial branches around are visibly pulsating. Care, however, must be observed for some days later, and no movement of the limb or manipulation of the sac are to be allowed; because in case of rapid cure, the clot that has filled the sac must of necessity be soft, and a very little may cause its displacement, and thus interfere with that natural contraction of the fibrin of the blood that is to fill the sac permanently, prevent its dilatation, and cure the disease. At Guy's Hospital, out of 17 cases of popliteal aneurism consecutively treated by pressure, 11 were cured, and Mr. Holmes informed us in his college lectures, that out of 124 cases so treated in different hospitals, 66 were treated with success, and in 58 without success. Of the latter, in 44, the femoral artery was afterwards tied, and in 8 amputation was practised, 5 dying. Death occurred in one case; and in 4 there was no evidence of subsequent treatment. ('Lancet,' Dec. 19, 1874.) In the majority of these cases, instrumental pressure was employed, and in some, the treatment was imperfectly carried out.

The treatment of aneurism by *direct compression* next claims attention, and in modern times is known as that by *flexion;* for there can be little doubt that the *modus operandi* of flexion in the cure of aneurism is mainly due to three conditions, *first,* to *direct* compression of the aneurismal tumor itself; *secondly,* to indirect compression through the medium of the tumor, intercepting either wholly or partially the supply of blood to the sac; and, *thirdly,* to displacement of the clot, as suggested by Holmes, and the consequent obliteration of the mouth of the aneurismal tumor. This mouth may likewise be so situated as to be closed by the bending of the artery—an aneurism in the posterior wall of the popliteal artery being in a far more favorable position for cure than one on the anterior. At the same time we know that forced flexion of a limb is capable of arresting the flow of blood through the healthy artery. In England, Mr. E. Hart demonstrated the success of this method of treatment in the year 1858, although, in 1857, Dr. Maunoir, of Geneva, recorded the first successful case in 'L'Echo Médicale' (Neufchatel), and, since that time, many surgeons have successfully applied the practice. To carry it out, the limb must be carefully bandaged from below upwards to the aneurism, and in the case of the popliteal artery the knee should be bent, sufficient force being employed to diminish or arrest the pulsation of the tumor but no more, some turns of the roller maintaining the limb in this position. The thigh should then be flexed upon the pelvis and the patient turned on his side with the limb resting on a pillow. By this plan the arrest of the circulation through the aneurism may generally be effected, and a cure expected. When the flexion is forced, the patient is too often unable to endure the suffering caused by the position. The plan, however, is so simple, and, when bearable, is so successful, that it should always be attempted where it can be applied, and, when unsuccessful, it is almost harmless. To large and rapidly growing aneurisms this method is inapplicable, and probably dangerous, as it may induce rupture; but when any inflammation or other complication exists it ought not to be employed; nor ought it be persisted in when it is not obviously doing good.

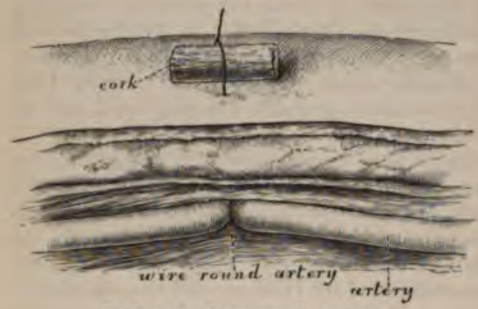
Pressure may likewise be used with flexion where the latter is insufficient, many cases having been reported in which success followed the conjoint means. In one under my care in 1871 I cured an aneurism below the popliteal space in eighteen hours, by alternating the flexion of the leg with digital pressure in the groin.

M. Liégois, in an interesting paper ('L'Union Méd.,' Aug. 1869), gives eleven cases in which flexion alone proved successful in popliteal aneurism, and also eleven in which it was successful in combination with other measures. In four it succeeded after other means had failed. On the other hand it failed in twenty-three cases, or nearly half the whole number, and of these, seven are stated to have suffered rupture, and one had inflammation of the sac. Holmes's statistics show nearly the same results.

The wire compress of Mr. Dix, of Hull, already alluded to (see p. 306), requires naming as a means of dealing with aneurism. It is a method that has been advocated by Porter, of Dublin, Hilliard, and others (*vide* Mr. Dix's paper in the 'British Medical Journal,' October 30, 1875, p. 551). It is in reality treatment by compression and not by strangulation. It does not cut the artery nor obliterate it at the seat of operation; therefore in principle and *methodus medendi*, it ranks not with the ligature, but with the tourniquet and other modes of pressure. But forasmuch as the application of the wire requires exposure of the artery by a cutting operation, this process cannot enter into surgical competition with the simpler methods of compression and flexion, yet where these have failed or are inapplicable and operative procedure is inevitable, "then," says the author, "I back my operation for certainty, rapidity, and safety, against any form of ligature—silk, hemp, or catgut—or, against any kind of forceps, 'artery constrictor,' or compressor applied in or through a wound."

The operation is as follows, and it seems to be specially necessary to follow out the exact details with care and attention :—

Fig. 134.



Dix's mode of compressing artery.

The artery is exposed by incision and the aneurism-needle passed in the usual way. A piece of surgical wire, about 9 inches long, is threaded through the eye of the aneurism-needle and carried beneath the artery by the withdrawl of the needle, which is then separated from the wire. A straight surgical needle is then attached to either end of the wire and the two needles (first one and then the other) are passed through the tissues to the surface, so that they emerge on the skin, one about a quarter of an inch and the other three quarters of an inch from the edge of the wound, on whichever side of it may seem most convenient, but *both on the same side* (Fig. 134). By drawing them through together, the wire forms a loop over the artery and the intervening tissues, and the needles are then detached from the wire. The half of a vial-cork, flat side downwards, is now placed on the skin between the ends of the protruding wire, and firmly pressed down by the fingers of an assistant *in the exact line of the artery*, the wire being at the same time drawn tightly upwards and sharply twisted over the cork, till the current through the artery is effectually stopped and the pulsation of the aneurism ceases. It is of great importance that the position of the cork should be longitudinally over the course of the artery so that the blood-current is checked as much by the downward pressure of the cork as by the upward tension of the wire, the intervening tissues forming a firm compressed pad. The superfluous ends of wire are then cut off, and the wound closed and dressed according to the predilections of the surgeon.

When the depression of anæsthesia goes off and the circulation revives, it will be found, that a *feeble* pulsation returns in the aneurism. This, according to the author (who strongly advocates the *gradual* rather than the *rapid* method of producing coagulation in the sac), should be allowed to go on for two or even three days, when the wire is to be tightened in the following manner :—

The cork being firmly pressed down over the artery, the wire is drawn upwards by gentle traction on its twisted ends, and two or three small wooden wedges are pushed in *by an assistant* between the cork and the wire, so that sufficient tension is caused to *entirely* stop all pulsation in the aneurism. If the wire has been sufficiently drawn tightly at first, very small wedges are required, such as two or three bits of a lucifer match, for instance. The wire is on no account to be twisted afresh, lest it break. Meanwhile, by the action of the two or three days' feeble current the sac has been prepared, as it were, for the coagulation of *sudden soft* clot which is now formed, whilst the collateral circulation has also by the same means been encouraged, the result being that in from twenty-four to forty-eight hours, consolidation is perfect; thus about the fifth or sixth day the cure is complete, and the compress may be removed, which is thus done: Untwist the wire and remove the cork; separate widely the two ends of the wire to lessen the curve as much as possible; clip off one end close to the skin; make gentle pressure with one finger where the cork has been, and by steady traction on the other end of the wire it is readily withdrawn. If it should seem to adhere, leave it till next day, when it must have become loosened in the tissues, and be easily removable.

The advantages of this method are thus summarized by Mr. Dix :—

I. The wire does not cause ulceration or any damage to the coats of the artery, either external or internal, therefore the blood channel being unopened, *bleeding*, one of the chief dangers of the old operation, *is impossible.*

II. By causing at first a *retarded* circulation and a diminished current, it most accurately imitates the *natural* cure of aneurism; and by allowing time for the establishment of the collateral circulation, the risk of gangrene, the *second great danger* of the ligature, is very much diminished.

If, neverthelsss, there were coldness of the limb and a threatening of gangrene, the wire can be at once untwisted and relaxed, or even removed.

III. Ultimately, the current through the artery and the sac is entirely obstructed so as to produce the needful clot. Of course, this complete obstruction can be effected at first if desired; and, therefore, this operation does what no operation, by ligature and forceps, &c., can do, viz., it gives the surgeon a choice between the rapid and the gradual method of treatment. But, as herein described, it is in fact a combination of the two, which is better than either alone.

It will be seen that, in the opinion of the author, the *gradual* method is much to be preferred, and he considers it one of the chief merits of his operation that this effect can be produced.

IV. The wire does not act as a foreign body in the wound, setting up suppuration and impeding the healing process as a ligature does.

V. It is not a fixture upon the artery remaining for an indefinite period, but, its work being done it can be at once got rid of.

VI. The clot produced by this concurrence of the gradual and rapid method is less likely to break down and suppurate than the soft sudden clot, which is the effect of the ligature.

VII. And lastly. As there is no possibility of bleeding from the artery, the surgeon has a wider choice of locality for operation. For instance, the common femoral or the external carotid, which, on account of hemorrhagic risks, are usually avoided by the operator, may be safely treated on this plan, which is indeed applicable to all arteries alike.

N.B.—Inasmuch as it does not obliterate the artery at the site of the application of the wire, this procedure, *in its present form*, is not suitable for the distal operation, but it is probable that complete occlusion and obliteration may be effected by the simple modification of applying *two* wires upon the vessel about half an inch apart, between which a clot would form and become organized.

All this is quite trustworthy in traumatic aneurism or in a wounded artery, a wire being applied on either side of the orifice in the artery and the vessel divided between them. This is proved by its perfect success in amputation, &c.

THE TREATMENT BY LIGATURE.

Such a plan should only be entertained when that by compression in one of its forms is inapplicable, or has proved unsuccessful. It should be carried out when possible by the Hunterian method (Fig. 135), by the application of a ligature at some distance from the sac and not by the "méthode d'Anel," in which the ligature is applied close to the aneurism; because by the Hunterian operation the chief flow of blood through the aneurism is arrested, the collateral circulation maintained, and the artery more likely to be healthy when ligatured at some distance from the seat of disease. The operation is also, as a rule, less difficult.

A moderately thick round ligature should be employed either of silk, hemp, or carbolized catgut. When a silk or hempen ligature is used, it subsequently ulcerates through, or a portion of the artery sloughs away with it. The process takes from nine to twenty days, or more in large vessels, and in this lies the weakness of the treatment by ligature. When the carbolized catgut ligature is employed, some ulceration of the vessel at the seat of ligature may likewise follow, but a complete division of the artery by ulceration need not take place. On that account the latter ligature is preferable. When the ligature fails, and death ensues, it is from gangrene of the parts below the seat of disease, or, from secondary hemorrhage. The former is the more frequent cause of death, and according to Dr. Norris, out of fifty fatal cases

FIG. 135.

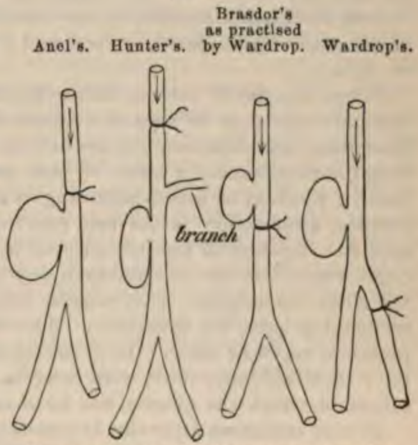


Diagram showing the different operations for aneurism.

of ligature of the femoral artery, twenty-three died of gangrene, and only eight of hemorrhage.

When a ligature is applied to the main artery of a limb, the circulation is, for a time, more or less cut off, consequently coldness of the part may ensue, and even gangrene; congestion, however, generally takes place gradually in the extremity from the blood being forced into the collateral vessels, and with this, some increase of temperature may be felt, with hyperæsthesia, a point already noticed in embolic arterial obstruction. Brown-Séquard explains the elevation of temperature that is often observed in a part after the application of a ligature to its main artery, by the paralysis of the vaso-motor nerves that ramify on or in the coats of the vessel; this paralysis producing a corresponding paralysis of the ramifications of the vessels, and, as a consequence, the blood finds its way freely through the collateral branches into the part below the seat of the ligature; this blood stasis producing both the congestion of the part as well as the concomitant elevation of temperature. ('Archives de Physiologie,' 1851.) The surgeon consequently should, after the application of a ligature, do what he can to maintain the temperature of the limb, which is best effected by covering it thickly with cotton wool, at the same time keeping the part raised, to encourage the venous circulation. Simple nutritious food should be allowed, but stimulants only with great caution, and merely enough to help digestion and maintain the force of the heart's action—the habits of the patient forming the best guide as to quantity. Should pain be present, opium, morphia, or chloral must be perscribed, either by the mouth or subcutaneously.

When the ligature has separated, the wound healed, and the aneurism consolidated, no forcible or prolonged exercise of the limb must be allowed for some weeks, although gentle exercise is beneficial. The limb should also be kept warm, for it has happened that the circulation through it has failed to become full or even sufficient, after the operation, and some permanent weakness and loss of sensation has been left. A patient may, however, live a long life even after a double operation. In 1864 I saw a man, æt. 51, upon whom Mr. B. Cooper had operated twenty-three years before (1841) for popliteal aneurism of the left leg, and of the right in 1843. He had been an orange porter, and subsequently followed his work. When gangrene takes place, it is generally as a direct result of the cutting off of arterial supply from a limb, and of the ensuing blood stasis. As a consequence it occurs within a few days of the operation. It may, however, be produced by the presence of an inflamed or rapidly increasing aneurism, and has then little or nothing to do with the operation. It should be dealt with energetically. If it spread rapidly, and threaten life, amputation of the limb about the line of ligature should be performed without delay. Should, however, it be limited in its nature, and slowly progressive, the expectant treatment must be employed. The warmth of the limb at the same time should be carefully looked to, the sloughing or dying parts covered with well-oiled lint, the venous circulation assisted by the elevated position and by gentle friction, and the powers of the patient stimulated by food and wine; opiates being administered for the alleviation of pain.

When the sac of the aneurism inflames and suppurates after the application of a ligature, the case may be regarded as one of local gangrene the result of the operation; it is a dangerous complication, and no definite rules can be laid down for its treatment. Hemorrhage is occasionally a result of this action, the blood coming from the lower end of the vessel; pyæmia or blood-poisoning is another. In general, when an aneurismal sac suppurates, amputation is the best practice when it can be performed. In August, 1871, I applied a ligature to the left carotid artery of a man æt. 29, for a large aneurism, and death ensued on the thirty-fourth day from suppuration of the sac and sloughing of nearly the whole aneurism. This process had been preceded by some hemorrhage on the thirteenth day after the operation. The same result may take place after the cure by compression, rapid or slow. It is an open question, however, whether aneurismal sacs that have been suddenly filled with coagula are not more liable to break up and suppurate than others in which the process has been more gradual.

In rare instances after the Hunterian operation the pulsation of an aneurism reappears; and a passing, feeble pulsation in the sac a day or two after the application of the ligature is by no means a rare occurrence; nor need it excite any alarm, as it is doubtless due to the passage of a feeble current of blood through the sac by means of a collateral branch. This is more likely to occur when a cure by pressure has been previously attempted and failed, the collateral circulation having been enlarged by the pressure. Should, however, the *pulsation continue persistent*, even after the application of a ligature to the main trunk, it will be fair to infer, that a 'vas aberrans' exists, by which the blood is brought irect to the aneurism, and which must be ligatured before a cure can be expected. At mes, the existence of this 'vas aberrans' may be made out at the time of operation when he vessel must be looked for before the main trunk is tied; indeed, it may be possible hat no necessity will be found to tie the main trunk, as the operation for aneurism is to ie the vessel that supplies the sac, and this may be connected only with the 'vas aberans.' Should it not be possible to apply a ligature to the supplying vessel, other means ay be employed, such as compression, or flexion, but, in all probability these had been reviously tried and failed, and, under such circumstances a second ligature may have to e put on near the sac; or the original operation for aneurism—that of Antyllus, practised more recently by Syme—may be required, which is, the laying open of the sac of the neurism and the application of a ligature above and below its connection with the artery. To do this, however, much boldness and operative skill are necessary to prevent a fatal hemorrhage. With this object, in a case of axillary aneurism, Mr. Syme made an incision above the clavicle along the border of the sterno-mastoid muscle to enable an assistant to compress the subclavian artery against the first rib; acting upon the same principle as he adopted thirty years before when he made an incision behind the angle of the jaw to enable an assistant to compress the internal maxillary artery before the removal of the upper jaw. In 1861, he laid open a gluteal aneurism, having previously thrust a bistoury into the tumor over the situation of the gluteal artery and introduced a finger so as to prevent the blood from flowing except by occasional gushes. He eventually thrust his hand into the sac, rapidly turned out the clot, and had the bleeding orifice at once under subjection by the pressure of the hand. Both cases did well. Still this practice is only applicable to desperate cases where all other modes of treatment have failed, or are out of the question. In aneurisms of small arteries, however, it is very applicable. I successfully employed it, some years ago, in a case of aneurism of the radial artery; and again in October, 1871, in a case of traumatic aneurism of the radial, where the vessel was punctured, about the middle of the arm. In the latter, I divided the vessel completely, and twisted both ends, a rapid recovery following.

When a ligature cannot be applied to the cardiac side of an aneurism, and the treatment by compression has failed or is inapplicable, Brasdor's, or the distal operation may be entertained. This consists in the application of a ligature to the vessel as it leaves the aneurism (Fig. 135). It is not, however, an operation that can be recommended with any confidence, except for carotid aneurism. Wardrop performed it in several cases with success.

The distal operation of the left carotid artery for the cure of aortic aneurism, is, however, well worthy of attention as is proved by the cases of C. Heath, Annandale, Holmes, and Barwell. The credit of the suggestion, however, must be given to Dr. Cockle, who wrote on the subject ('Lancet,' 1869), although three or four cases had previously been recorded in which the operation had been performed for supposed carotid aneurism with success. In aneurism of the innominate artery, it is also open to the surgeon to ligature the carotid and subclavian arteries consecutively or simultaneously, Mr. Fearn's case and others having made the repetition of the operation justifiable. In August, 1871, I performed Wardrop's operation on a man, æt. 33, for innominate aneurism. The subclavian was ligatured with a carbolized catgut ligature, the wound closed and sealed with lint saturated with the compound tincture of benzoin. A good recovery ensued, and considerable consolidation of the aneurism. The man left the hospital thirty-six days after the operation so well satisfied with the success of the treatment that he did not return to have the carotid ligatured; indeed, he went on so well up to about six weeks before his death that he thought nothing of his trouble. He died from dyspnœa the result of pressure, in August, 1874, three years after the operation. After death the aneurism was found to be full of solid clot, and there was a passage through it to the carotid, with a smooth lining. Unfortunately, the gentleman who took out the preparation threw away the bulk of the clot that filled the sac, which was as big as a fist. The success of the operation, however, was most encouraging.

THE TREATMENT BY MANIPULATION.

This method also requires notice, since it has been introduced by no less a man than Sir W. Fergusson, and is based on natural although exceptional processes, viz., the embolic occlusion of the distal end of an artery by a dislodged clot. Manipulation may also be employed "to alter the relations of the laminated fibrine in the cavity of the aneurism, so as to bring about a further deposition of fibrine on the projecting surfaces of the displaced laminæ" (Oliver Pemberton's 'Address on Surgery,' Brit. Med. Assoc.). In two cases Sir W. Fergusson endeavored by manipulating the sac to dislodge the clot, and thus give it a chance of being carried by the circulation into the efferent vessel. In both the success was sufficient to sanction the repetition of the means in appropriate cases when all other treatment is out of the question. In 1872, Mr. Herbert Page, of Carlisle, also successfully treated a case of popliteal aneurism by these means. In the cervical aneurism, the dangers of embolism of the cerebral arteries must be borne in mind; yet at the same time it should be remembered that the Hunterian operation for subclavian aneurism has never been successful, and all other means are nearly out of court. Amputation has, however, been performed under these circumstances with success.

GALVANO-PUNCTURE, OR ELECTROLYSIS.

To induce or assist coagulation of the blood in the sac, other means have been suggested, and of these *the treatment by galvano-puncture* as advocated by Abeille in 1849 ('Arch. Gén. de Médecine'), and by Ciniselli in 1856, is one of the most promising in theory, though the practical results have not been equally satisfactory. It consists in the introduction of the two needles of a constant current battery into the sac, with the view of coagulating the blood into a firm clot. The practice is one that can only be entertained in exceptional cases, *i. e.*, in those which cannot from their position be submitted to other forms of operation. It is, however, well adapted for the treatment of aneurisms at the root of the neck and the thoracic aorta, and possibly for some forms of abdominal aneurisms.

The constant current battery should be used, and a moderate current, say of five cells, be first employed, its strength being increased gradually, but never to cause pain. The battery may be used for half an hour at a time, about twice a week, yet this will depend upon its effects. The needles should be of steel gilt, sharp, very fine, and about three inches long, and should be insulated to within half an inch of the point. They are to be introduced and removed with a rotatory motion, and may be attached to either pole of the battery. The dangers of the operation are, as stated by Holmes, principally from two causes, "the inflammatory action produced in the sac and the cellular tissue which surrounds it, and the gangrene or ulceration of the skin at the points of entrance of the needles."

OTHER METHODS.

THE TREATMENT BY INJECTION is another mode that demands notice, although hitherto it has not been satisfactory. Alcohol, tannin, acetic acid and the perchloride of iron have all been used as coagulating agents, but the last is the drug for which the most can be said. That it has a powerful influence in causing the coagulation of the blood is well known; but to produce this in the sac of an aneurism is a dangerous proceeding. The most dangerous result is embolism, and the next, inflammation and suppuration of the sac. A solution of the perchloride, diluted to one-twentieth the strength of the British Pharmacopœia solution, is strong enough, and not more than about twenty drops of the solution ought to be thrown into a large sac. The graduated glass syringe with screw piston should be employed, such as is generally used for subcutaneous injections. Care should be taken that the perforated trocar be well introduced into the cavity of the tumor, and that the afferent as well as efferent artery be well compressed. The escape of arterial blood is the only test of the trocar having entered the sac. The fluid should then be injected, and, by manipulation, mixed with the blood. When the sac seems solid, the canula should be withdrawn, but the pressure upon the cardiac side of the sac should be maintained subsequently for a full hour, to prevent the consolidating mixture of blood and iron being sent onwards into the circulation.

With objects similar to the above, the late Mr. Moore inserted twenty-six yards of iron wire into an aortic aneurism through a canula, his object being merely to detain the fibrine of the fluid blood; but the result was discouraging in the extreme. ('Med.-Chir. Trans., vol. xlvii.) Dr. J. Levis, of Philadelphia, in October, 1873, inserted twenty-four feet of horsehair into a thoracic aneurism in a man aged 41, with some advantage, and on November 25th, 1873, I adopted a like practice, introducing into the sac of a rapidly increasing popliteal aneurism due to embolism, twenty feet of horsehair through a fine canula, with the effect of causing almost complete consolidation of the tumor. The patient was a man, æt. 33, admitted with ulcerative endocarditis, who survived the operation five days. The results thus obtained are quite sufficient, therefore, to justify a repetition of the operation, under circumstances in which all other plans of treatment are unjustifiable or have failed.

In recent times Langenbeck, with the view of causing contraction of the walls of an aneurism, has been led to inject the parts surrounding the sac with a solution of ergotin. Dr. Dutoit, of Berne, relates in 'Langenbeck's Archiv' (Band xii, No. 3) a case in which he successfully adopted the practice; the man was forty years old, and the aneurism was supposed to be subclavian. Fifteen injections were made at intervals of two or three days *over* the tumor, which gradually diminished. To render the cure certain, however, digital compression was subsequently employed.

TRAUMATIC ANEURISM.

An artery receives a punctured or an incised wound; bleeding takes place; pressure is applied in order to control it, and the wound heals. In course of time a pulsating swelling is discovered and a traumatic aneurism is said to exist.

A man in wrestling, or after making some sudden unprepared-for muscular exertion, finds something give way in his leg, or fancies he has sprained his knee. In a shorter or longer period swelling appears, which steadily increases and is pulsatile, he is the subject of an aneurism. In the *former* case, doubtless the injury was the direct cause of the aneurism. In the *latter* it produced it indirectly by acting upon a diseased vessel. And yet, if the former aneurism is sacculated either by the expansion of the reparative material with which the wound of the artery had been closed, or by the hernial protrusion of one or more of the coats of the artery through a rupture or wound of another, or by the condensation of the cellular tissue into which the blood has escaped, it differs in no single practical point from the latter or from any other aneurism that has been already considered; and, what is more, it must be treated on the same principles, although as the artery of a traumatic is healthier than that of a spontaneously formed aneurism, the former may be more readily cured.

When, however, an aneurism caused by any injury is not encysted; when either from the first it is diffused or becomes so from the rupture of the sac, or, when any ordinary aneurism ruptures, a different condition presents itself to the surgeon, and the case appears more like that of a ruptured artery; indeed, when such a condition complicates a sprain, fracture, or dislocation, it must be regarded as such, and treated accordingly. The vessel, however, is not to be cut down upon and tied at once as a matter of course, because such a practice would be wrong and rash in the extreme—a large proportion of such cases as these recovering without any such proceeding. In one where the extravasation is severe and no pulsation exists, it is impossible to make out with any clearness the true condition of affairs. A limb either with or without a fracture may be greatly distended, and this from effused blood; but whether the blood has been poured out from the rupture of a large artery or vein, or some smaller vessel, there can be no means of knowing, since even the pulsation in the vessels below may be indistinguishable on account of the effusion. Under these circumstances no active proceeding can be carried out. The limb should be elevated, cold applied, the case left to nature, and, in a large number of instances a beneficial result will ensue. I can recall several such cases where I anticipated bad results, but witnessed good. If the effusion is so severe as to be followed by evidence of arrest of circulation in the limb, the surgeon will be justified in cutting down upon the vessel at the point where the history of the case indicates that it is wounded, and in tying both ends after having turned out all clot, &c. In other cases, the main artery may be tied, but too often there will be nothing to be done but amputation, as gangrene may set in. This operation, however, must be postponed till the line of demarcation is fairly indicated. No general rule can be laid down for the treatment of all these cases as each one must be treated on its own merits.

But the student should remember—(1) That every aneurism, however caused, if encysted, is to be treated upon the same general principles, and that ruptured traumatic aneurisms are to be regarded as ruptured arteries.

(2) That the rupture of an artery when bound down by a dense fascia, such as the popliteal, is generally followed by complete arrest of all circulation in the limb both arterial and venous, and, as a rule, requires to be treated by amputation, gangrene being otherwise the result.

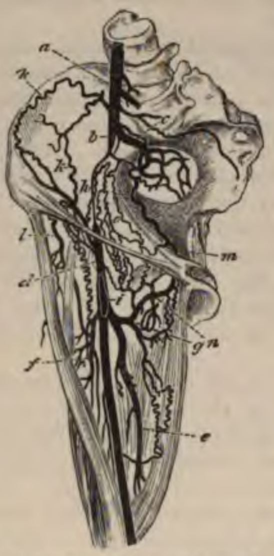
(3) That in cases of partial rupture there may be less extravasation, and consequently less severe measures may suffice; such as pressure upon the main trunk above, or, if this fail, the application of a ligature to the wounded vessel.

(4) That a ruptured artery in parts less fascia-bound than the leg (as, for instance, the arm) may be treated more as in the case of injuries to arteries by the application of a ligature to the wounded vessel.

When an artery is obstructed, the circulation is carried on by what is called the collateral circulation, the vessels coming off above the obstructed part communicating with those which arise below it. At first the vessels are very numerous, but as time goes on their number diminishes, only those most conveniently situated for carrying on the circulation becoming rapidly or gradually permanently enlarged.

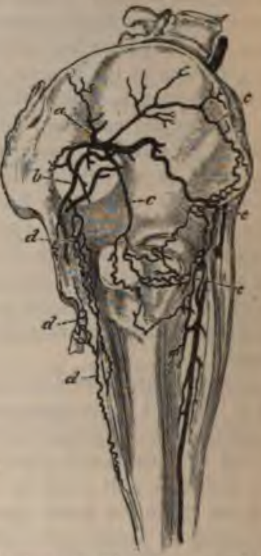
To illustrate this beautiful compensatory natural act I submit two drawings (Figs. 136, 137), taken from a preparation in Guy's Museum, No. 1519¹², made by Mr. Cock in the year 1826, from a patient æt. 58, in which case Sir A. Cooper had applied a ligature to the external iliac artery, eighteen years and a half previously, for femoral aneurism.

Fig. 136.



Anterior view.—*a*. Common iliac artery. *b*. External iliac. *c*. Internal iliac. *d*. Femoral. *e*. Profunda. *f*. External circumflex. *g*. Internal circumflex. *h*. Iliac artery, which had been tied and had shrivelled into a cord. *i*. Remains of aneurismal sac. *k*. Anastomosing branches of the circumflexa ilii. *l*. Anastomosing branches of the circumflexa externa. *m*. Obturator artery, anastomosing with *n*, circumflexa interna.

Fig. 137.



Posterior view.—*a*. Gluteal artery. *b*. Ischiatic artery. *c*. Anastomosing branches of gluteal with the circumflex. *d*. Anastomosing branches of ischiatic with the perforating branches of the profunda.

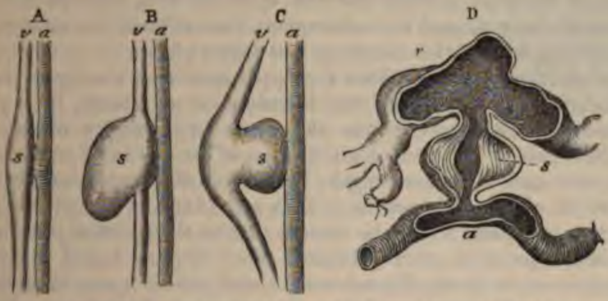
A full description and preparation of the case is to be found in the first volume (first series) of the 'Guy's Reports,' by Mr. Cock. The drawings need no lengthy description, as they explain themselves.

Arterio-venous Aneurisms.

When an artery and a vein communicate with each other, the arterial blood passing *directly* into the vein without the intervention of a sac, *an aneurismal varix* is said to exist (A, Fig. 138); and when a sac exists into which the arterial blood flows in its passage to the vein, this condition is called *a varicose aneurism* (B, C, and D, Fig. 138). Both these varieties of arterio-venous aneurisms are now rare; but when venesection was a common operation they were far more frequent; as they are usually produced by the perforation or division of an artery through a vein, the opening between the vessels remaining permanent. Goupil (Paris, 1855) recorded the fact, that out of fifty-seven cases of this affection, thirty-one were the result of bleeding. Yet both forms may originate spontaneously from disease. Cases are also on record where the aorta and superior or inferior vena cava communicated. Wade ('Dublin Med. Press,' 1861) has also recorded a case in which an opening existed between the aorta and pulmonary artery; and my friend Mr. Morris informs me, that he has seen a case in the femoral gion, the result of a pistol shot received by a sportsman in America. Indeed, all the rge arteries and veins may be similarly affected.

In an *aneurismal varix* the vein assumes in some degree the properties of an artery nd becomes enlarged from the arterial impulse. Besides being irregularly dilated and rtuous, the dilatation assumes a fusiform or sacculated appearance, while it also becomes hickened and pulsates.

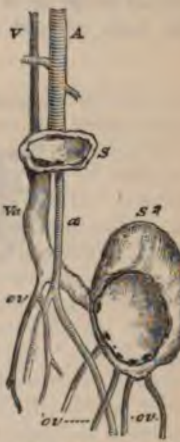
FIG. 138.



Illustrating the different forms of arterio-venous aneurism. A. The artery and vein directly communicating. B and C. The dilation being more in the vein. D. Varicose aneurism laid open.

In the *varicose aneurism* the sac may or may not freely communicate with the artery or vein. In some cases it will involve the whole calibre of both vessels; or the vein may be hypertrophied and enlarged, as in the aneurismal varix. In a unique case (Fig. 139) recorded by Mr. Cock ('Med. Chir. Trans.' 1851), of a traumatic varicose aneurism of the popliteal artery, the sac was small but involved the whole calibre of the artery and vein, and the whole of the arterial blood passed through it. The secondary effects of the disease were also shown with singular clearness. It occurred in a man æt. 28, who eleven years previously had received a punctured wound in the popliteal artery for which two weeks subsequently, on account of secondary hemorrhage, the femoral was ligatured. He convalesced and returned to his work, but two years afterwards became the subject of "varicose veins." He remained well until three or four months before his admission into Guy's, when he had fever, and, on convalescing and trying to walk, discovered his leg was stiff, painful and swollen. He was admitted with what was supposed to be a large collection of pus beneath the superficial muscles of the calf. The femoral artery below Poupart's ligament and the anterior and posterior tibial arteries were pulsating freely. The cavity was opened, some ounces of dark grumous, pitchy, non-coagulable blood escaped. The next day a quantity of offensive pus flowed away mixed with coagula. For a fortnight everything went well, when arterial hemorrhage took place, and he lost nearly three pints of blood. After due consultation, amputation was performed, from which an excellent recovery ensued.

FIG. 139.



Mr. Cock's case of arterio-venous aneurism.

On dissecting the limb, Mr. Poland found connected with the popliteal artery an aneurismal sac (Fig. 139, *s*) the size of a pigeon's egg; which was of cartilaginous hardness, and lined with fibrine. The artery (*A*) freely entered the sac from above. The vein (*V*) was obstructed above with coagulated blood, and below was lost in the walls of the sac as a fibrous cord. From the lower part of the sac two vessels issued, the smaller one (*a*) was the continuation of the popliteal artery *greatly diminished in size*, which divided as usual to the leg. The larger (*Va*) was the popliteal vein greatly hypertropied, pouched, and puckered. It was quite pervious, and passed down for about two inches, when it divided into two trunks; one, which accompanied the anterior tibial artery, was quite *obliterated*, the other led directly into a *second aneurismal sac* (s^2) the size of a duck's egg, with the walls of which its coats became identified. It was this that had been opened. From the lower part of this *venous sac* emerged three or four large impervious branches that were clearly veins accompanying the posterior tibial and peroneal arteries. The contents of these veins could be washed out and the valves seen.

It should be added that the cutaneous veins above described as varicose were greatly hypertrophied, and it was evident that the whole of the blood from the leg was returned through them.

It would appear also that in this case, as a *direct* result of an injury, a *varicose aneurism* formed, into which the whole of the arterial blood flowed. Moreover—

That the arterial blood subsequently found a more direct course through the popliteal vein than through the artery, and as a result the vein became hypertrophied and the artery atrophied. Also—

That the force of the arterial blood current upon the thin coats of the vein caused the gradual dilatation of the vein and the subsequent formation of an aneurism in its course; and that by the giving way of this bleeding had taken place.

The wasting of the femoral vein *above* the upper sac, with the hypertrophy of the same vein *below* the sac, from its taking on the functions of an artery, is a point of interest; and not the least interesting point was the great hypertrophy of the cutaneous veins through which the whole of the venous circulation of the leg must have been carried on.

I have given this case at some length, because it illustrates better than any general description the whole effects, primary as well as secondary, of a varicose aneurism.

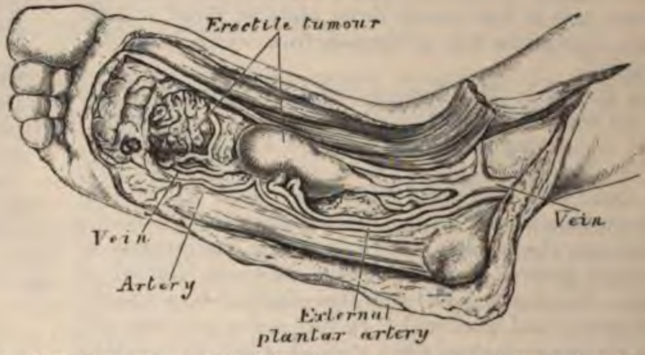
With reference to diagnosis it may be stated, that at the point of junction of the arterial and venous streams, a peculiar purring bruit is often felt and heard—this bruit frequently extending down the course of the dilated veins; and, where a sac, in which the two blood currents meet, separates the artery and the vein, there is likewise a soft bruit. The sac is rarely very large, and is made up of condensed cellular tissue and plastic matter.

TREATMENT.—In neither of these cases is surgical interference generally required. Should the disease be extensive, and either from pain, mechanical causes, or chances of rupture of the vessels, require treatment, a cure may be attempted by compression of the artery above and the vein below. When the disease is in the bend of the elbow, by forcible flexion of the forearm on the arm and supination of the hand, the brachial artery being in this manner fairly obstructed; a pad may likewise be placed upon the point of communication between the two canals, to make the pressure more perfect. Indirect compression in any other of its forms can also be tried; and, on these failing, the case must be treated as one of wounded artery—the vessel must be cut down upon, and a ligature placed on either side of the opening. The veins need not be interfered with, as they will gradually wither so soon as their arterial communication has been cut off.

CIRSOID ANEURISM, ERECTILE TUMORS, AND ANEURISM BY ANASTOMOSIS.

These have nothing in common with the spontaneous and traumatic aneurisms that have been already described, besides being diseases of the arterial system. They are vascular tumors made up of arterial tissue and formed by a dilatation and elongation of arteries; the term *cirsoid aneurism* being employed when the trunks of the larger vessels are involved, and *aneurism by anastomosis* when the smaller vessels or capillaries are affected. In the cirsoid aneurism, one vessel or many vessels may be diseased—the disease showing itself by the artery becoming tortuous, dilated into pouches, and convoluted. When one vessel alone is affected Gosselin called it *arterial varix*. When the disease is on the scalp (its most common seat), three or four large tortuous arteries may be seen converging to a centre, where a congeries of dilated arteries will be found, pro-

FIG. 140.



This drawing was taken from a patient of Mr. Poland's, a girl æt. 19. The disease followed an injury, and was treated by amputation, other measures having failed ('Guy's Hosp. Rep.,' 1859).

bably of new growth. It may, however, affect the arteries of the extremity. I have seen it in the foot, Fig. 140, and Cruveilhier has reported a case in which the external iliac artery was so affected. Cirsoid aneurism is generally found in young people, during the period of growth, and in the majority of cases can be traced to local injury. It can be readily made out by its pulsating nature, and the peculiar tortuous and convoluted appearance of the diseased vessels, not only of the vessels forming the tumor, but of the arteries by which it is supplied.

TREATMENT.—All forms of treatment have been tried in these cases, such as direct pressure, injection, the application of ligatures to the vessels that converge towards the growth, and to the main artery that goes to the part: the tumor has, moreover, been laid open and treated by pressure, with the view of causing its obliteration by inflammatory exudation; Gräf, Bell, Arnott, and Lawrence have each recorded successful instances of this form of practice, but no good success in the majority of cases has been achieved.

The best success has, however, followed the removal of the growth either by the application of the ligature or by excision. In 1876 I excised a cirsoid aneurism, situated below the jaw in connection with the facial artery, from a lady, æt. 25, with success. In 1867 I treated a boy aged 14 for a large cirsoid aneurism of four years' growth situated on the right temple. It was supplied with blood by tortuous vessels converging from all quarters, and pulsated freely; I applied acupressure pins to all these vessels, even to their division, without success; the growth for the time became flaccid, but quickly reappeared and increased. Under these circumstances I excised the tumor, making my incisions at some distance from its margin, and ligatured about twenty large vessels as I proceeded; a rapid recovery followed, and the boy was well three years later. In this case it was remarkable to see how rapidly the tortuous convoluted arteries that supplied the tumor withered and became of their normal size so soon as the central disease was removed. This process illustrates John Hunter's opinion that "vessels have a power of increase within themselves, both in diameter and in length, which is according to the necessity, whether natural or diseased;" and indicates that the attracting power had its centre in the growth, and not in the afferent arteries. In a third case, that of a girl æt. 12, I removed the growth by a subcutaneous ligature with like success; and, more recently, in a man who had such a vascular pulsatile growth in his left cheek, which appeared to have had all the afferent arteries tied without success before he came into my hands. I ligatured the whole mass subcutaneously, and a recovery followed. Four years later, however, the disease returned, and in June, 1877, I excised it—the wound healing rapidly. Indeed, the only successful cases of treatment of cirsoid aneurism that I have dealt with or seen, have been those in which the growth itself was treated by removal.

Cases of aneurism by anastomosis are very amenable to treatment by styptic injection, the galvano-cautery, or the ligature.

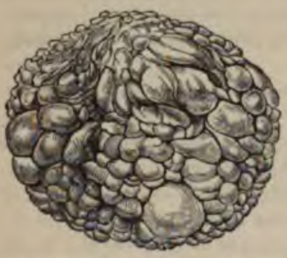
NÆVUS.

Telangeiectasis, Erectile Tumor, or Angeioma, is essentially a disease of the capillaries, appearing in a general way to be made up of a mass of vascular tissue, the tubes freely intercommunicating with each other. It is true the walls of the vessels are indistinguishable in an advanced case of the disease, the nævus appearing as a collection of cells or spaces, opening widely into one another, through which blood flows. When the arterial supply is very free, the growth appears florid, warm, and pulsatile, and is then called an *arterial nævus;* when the venous element predominates, the growth is less florid, has a congested bluish appearance and does not pulsate, and is termed a *venous nævus.*

These growths for the most part appear in the skin or subcutaneous tissue, are frequent on the head and often multiple. Rare examples are on record where they affected deeper parts, even the viscera and the brain (*vide* Wilks and Moxon, 'Path. Anat.,' and Morris, 'Path. Trans.,' vol. xxii). In a clinical point of view they may be divided into the *cutaneous* or pure skin nævus, the *subcutaneous* or cellular tissue nævus, and, the *mixed form* where both tissues are involved; which distinction has an important practical bearing. Nævi are, as a rule, diffused, that is, they have no distinct capsule, but in many cases they are encysted, and may be treated accordingly. Venous subcutaneous nævi appear to be more frequently encapsuled than the cutaneous and arterial.

Nævi, moreover, are generally congenital, or make their appearance soon after birth. They occur, however, at a later period of life and then seem to be due to some injury or wound. These nævi at times grow quickly, the cutaneous form rapidly spreading; the more florid and arterial the growth the greater is its tendency to spread; the venous nævus is less progressive. They may grow also for a time and then stop; indeed, they all have a tendency to become stationary after a period, and even to degenerate. It is not uncommon to meet with nævi that have begun to undergo this process before the birth of the child; and I could adduce many cases in which the nævus was ulcerated or even sloughing at birth. In feeble or cachectic children it is not uncommon for these "marks" to ulcerate or slough, and, after measles, fever, or other depressing illness, the destruction of the growth is sometimes very rapid. These facts show that nævi, although blood tumors, are not long-lived growths and have a tendency towards early death. When they do not ulcerate or slough, they undergo degenerative changes, and the most characteristic is the cystic form (Fig. 141). When the skin undergoes this change, the surface becomes warty and vesicular, the vesicles containing more or less blood-stained serum. When the cellular tissue is the part involved, cysts will still appear of a like nature, but occasionally the whole growth passes into a mass of cysts of different sizes bound together by fibrous tissue. This degenerative change is very typical. To account for the formation of these cysts is no easy matter, no satisfactory explanation indeed of their production has yet been given.

FIG. 141.



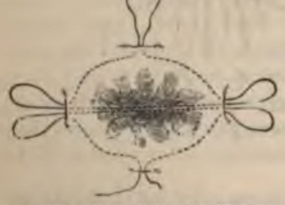
Drawing of degenerating nævus. Guy's Mus., 160^{84}.—Hilton's case.

Some nævi are pigmentary and are then termed moles. They are far less vascular than the forms already alluded to and have no tendency to spread. They grow, it is true, with the growth of the subject, but as a rule in no greater proportion; in exceptional instances their increase is rapid. They do not appear to have a tendency to ulcerate, slough, or undergo the cystic degeneration like the vascular nævi, but have a special tendency to become the seat of cancerous disease, and particularly of the melanotic form of cancer. That is, subjects, who become the victims of cancer and have moles, are often attacked primarily in such structures, and, as the cancer originates in a pigmentary growth, it takes on its character and becomes melanotic. I have seen many such cases, and so many others have now been recorded as to place the question beyond doubt.

TREATMENT.—Unless a nævus is so situated as to be an eye-sore or an inconvenience, or unless it show a decided tendency to rapid increase, there is no necessity for operative interference. For a certainty, after a time, it will cease to grow, and also as certainly degenerate or waste, so that under such circumstances it is not necessary to interfere. Should, however, the nævus be so situated as to be an inconvenience or a deformity; or should it grow so rapidly as to threaten to become either, something must be attempted, and this something is to be determined by the nature of the nævus and of the tissue in which it is placed. If *purely cutaneous* and not involving deeper tissues, it may be destroyed by some external application, such as caustics, nitric acid, or potassa fusa, chloride of zinc, or tartarized antimony, the two former being applied directly to the part, the two latter in the form of Vienna paste, or otherwise. The hot iron and the gas or galvanic cautery are also very valuable destructive agents; one touch of either of these latter, steadily applied, destroying the growth, and with but little pain.

In the *purely subcutaneous nævus* the treatment by caustics or cautery applied as a caustic is clearly inapplicable. When encysted, as very often it is, *incision* is the best remedy, but care should be taken to save the skin. When such treatment cannot be adopted the nævus may be strangled by a ligature applied subcutaneously, as illustrated in the drawing Fig. 142, or it may be injected with the perchloride of iron of the pharmacopœia strength, with a solution of tannin in water in the proportion of ʒj to ℥j, or of the chloride of zinc grs. xij to ℥j of water, about twenty drops being thrown into the centre of the growth, care being taken beforehand to tear up the texture of the tumor with a needle. The object of this treatment is to coagulate the blood in the tissue, and thus promote its consolidation and cure. In many cases injection causes inflammation, suppuration, or even sloughing of the growth, and though in this manner a cure may be obtained, it is often by deformity.

FIG. 142.



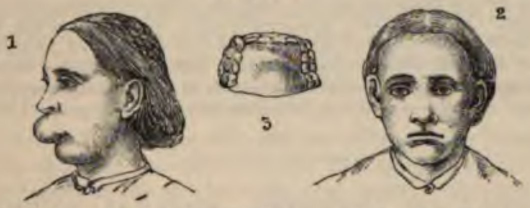
Mixed nævus with the ligature inserted round its base subcutaneously before being tied.

The treatment by injection when the nævus is on the head or trunk is, however, attended with great danger, more particularly from embolism. I lost a patient where the nævus was on the cheek from this cause in a few minutes after the operation. For the above reason it is well to apply a ligature to the base of the growth and then inject; or to isolate the growth by means of the pressure of a metallic ring *before* injecting.

In the *mixed variety*, when the skin appears to have been involved secondarily by the extension of the disease from the cellular tissue, the nævus may be treated by excision, subcutaneous ligature, or injection.

When the skin, with the cellular tissue, is extensively involved and the nævus defined, the whole may be removed by excision; but when otherwise, by ligature. When the nævus is pendulous, or when it can be isolated from the parts beneath, excision is most suitable, and, when hemorrhage is dreaded, the base of the growth may be previously held in a flat clamp. In several instances I have excised the nævus by cutting on pins that have been inserted beneath its base; keeping the pins as points round which a ligature might be applied, and, by which the edges of the wound might be brought together. When the thickness of the lip is involved in the disease and the disease is limited, a V piece may be taken out with the growth advantageously, but when the whole lip is involved the growth may be dissected out, leaving the skin. The drawing below is of a case in which this operation was successfully practised (Fig. 143).

Fig. 143.

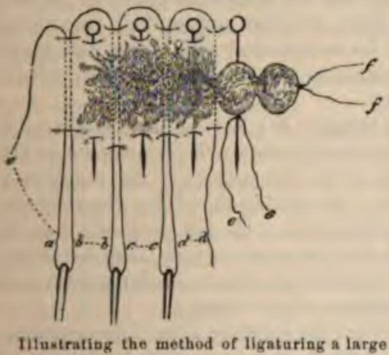


1. Nævus involving the whole of the upper lip. 2. After removal.
3. Flattening of the teeth from the pressure of the nævus. (From 'Guy's Reports.')

Within the last few years I have successfully treated many of the mixed varieties of nævi with the galvanic cautery, by simply perforating them with the heated needle in many points (ignipuncture).

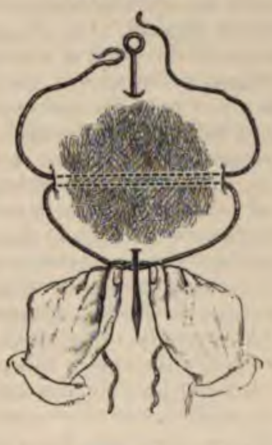
The treatment of a diffused nævus by means of setons is a practice that can also be strongly recommended. Several setons steeped in the solution of the perchloride of iron are often sufficient to coagulate the blood, or to set up enough inflammatory action to cure the growth. When a nævus is extensive and is to be treated by the ligature, it may be dealt with piecemeal (Fig. 144). It occasionally happens that the ligaturing of half a nævus cures the whole by the extension of the inflammatory action. In nævi involving the eyelids this suggestion is ot value, and, in my own practice, several instances of cure have followed the application of a ligature to half the growth.

Fig. 144.



Illustrating the method of ligaturing a large mixed nævus in sections around pins. At one end the pin has been removed, and the knot completed (*f*).

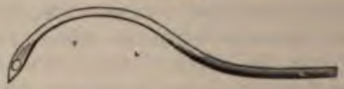
Fig. 144A.



In a mixed nævus of moderate size when the cure by ligature is to be carried out, a pin may be passed beneath the growth, and also a needle at right angles to the pin, armed with a double ligature (Fig. 144A). The nævus is then strangled in halves by the ligatures tightly drawn beneath the pin; but before the ligatures are finally tightened it is well to puncture it to let out the serum and blood, to relieve tension, and to allow of the more perfect strangulation of the growth. When this act is completed the pin may generally be removed.

Small nævi may be vaccinated, although the chances of a cure by such means are very small. The same also must be said for compression.

FIG. 145.



The best needle for the application of a subcutaneous ligature to a nævus is shown above.

Richet, "Aneurism," in 'Dict. de Méd. et de Chir. Prat.,' vol. ii.—*Léon de Fort*, 'Diction. Encyclopédique des Sciences Médicales,' 1866.—*Broca*, 'Traité des Aneurysmes,' 1856.—*Lisfranc*, 'Des différens Méthodes, &c., pour l'Oblitération des Artères,' 1834.—*Scarpa*, 'On Aneurism,' Wishart's Translation.—*Bellingham*, 'On Aneurism,' 1847.—*Tufnell*, 'On Treatment of Aneurism by Compression,' 1851.—*Holmes*, 'System of Surgery,' 2d ed., 1870.—*Hodgson*, 'On Arteries and Veins,' 1815.—*Dr. Norris*, 'American Journal.'—*Dr. Stephen Smith*, Ditto.—*Erichsen's* Cooper's 'Surgical Dic.' 1861.—*Wardrop*, 'Cyclop. of Surgery.'—*Syme*, 'Observ. in Clinical Surgery,' 1861.—*Fergusson, Sir W.*, 'Med.-Chir. Trans.,' vol. xl.—*Dr. Jones*, 'On Hemorrhage.'—*Bryant*, 'Lancet,' April 4, 1874.

THE LIGATURE OF ARTERIES.—SPECIAL ANEURISMS, &c.

John Bell wrote seventy years ago "that the right way of securing a great artery is perhaps one of the most important points in practical surgery;" and to do this with nicety and precision requires a sounder and more accurate knowledge of anatomy than any other operation.

"Before undertaking to tie an artery, the surgeon ought to know its general course and its relations, and especially the prominent part or parts which are to guide him to the position of the vessel; he ought to have familiarized himself by frequent dissection with the thickness of the parts covering it, and their appearance as far as that can be judged of in the dead body; and finally, he ought to know the usual position of its principal branches, and the anastomosis by which the circulation may be expected to be restored. It is advisable also to be aware of the leading peculiarities in course, relations, bifurcation, &c., which the operator may perhaps meet with, and for which he ought to be prepared." ('Holmes's System,' vol. iii, p. 545.) In fact, without anatomical knowledge, any attempt to tie the trunk of a large artery must be surrounded with difficulties and fraught with danger, whilst with it, the operation becomes in the hands of an experienced surgeon an act of precision and apparent simplicity.

In a former chapter, the mode of applying a ligature to a divided artery after operation, was discussed and illustrated; and in the present, attention will be directed to the application of a ligature to *an artery in continuity* as in the operation for aneurism, or the arrest of hemorrhage from a punctured wound. To accomplish this, the surgeon has to go through several stages of thought as well as of action. He has *first* of all to make out with precision the *exact course of the vessel to be ligatured*—which may be done by the artificial linear guides with which he ought to be familiar, the muscular guides to its position, and the recollection of the anatomical relations of the vessel.

He has, *secondly*, to decide on *the point at which the ligature should be applied.* When for a *wound* in the vessel, this point is already settled, it having been laid down as a rule that, whenever possible, a wounded artery is to be exposed at the seat of injury, and two ligatures applied, one above and below the seat of lesion.

When for *aneurism*, the question is more open, the 'point for ligature' having to be determined by the surgeon. In deciding this important question, it should be remembered, that if the ligature be applied *too near* the aneurism, there is a risk of the ligatured vessel partaking of the disease for which the operation is required; and if *too far off*, the circulation through the aneurismal sac may be too free on account of the collateral circulation of the part.

But above all, the surgeon should avoid selecting a spot *where an artery bifurcates or gives off large branches;* as under these circumstances, the clot that is required to plug the vessel behind the ligature must be absent, and one of Nature's most important hæmostatic agents become lost.

With the decision of these primary and important points the operation itself has to be considered, which resolves itself into *the exposure of the artery, its isolation, the application of the ligature around it, and the after-treatment;* the position of the patient for the operation being previously determined.

The position of the patient should be such as to render prominent the anatomical guides to the course of the artery, to make the skin tense and to facilitate its division. *It should, moreover, be one of extension,* yet after the artery has been exposed, it is well to remember that the muscles of the part must be *relaxed,* as the artery is thus better brought into view, and the subsequent steps of the operation are rendered more easy.

The exposure of the artery is to be made by incision, its course having been clearly made out, and the point determined on beforehand for the application of the ligature. The incision should be in the course of the vessel, its centre corresponding to the point where the ligature is to be applied, an occasional obliquity being sometimes practised when the exact position of an intermuscular interspace in which the vessel lies, is uncertain, and when the artery lies deep. It should, moreover, be free. It need not be so long in a thin as in a fat subject, nor in a case of superficial artery as in that of a deep vessel; but, under all circumstances, the skin wound should be enough to allow room for manipulation.

The first incision should include the skin and superficial fascia down to the deep fascia, and, in making it, the operator has only to avoid the division of any large vein such as the external jugular in operations on the neck; or, saphena, in operations on the thigh. He should, consequently, mark out their position by arresting the circulation through them on their cardiac side, and make his incision parallel with them when they lie in his course.

When the deep fascia is exposed, it should be laid open, and in this step, the use of a director is sometimes valuable; the fascia, moreover, should always be divided to the full extent of the external incision. The student should remember that the trunks of all arteries, except the cutaneous, are covered in by fascia. With the division of the fascia, the use of the knife can for a time be dispensed with, as the intermuscular septa and cellular tissue are readily separated by the handle of the instrument or finger, so that the sheath of the vessel can be thus well exposed.

If, writes Malgaigne, "immediately after the first incision, the surgeon attempts to find the artery, he tries an impossibility, since he cannot reach it till after the last incision." He will then proceed uncertainly, and at random, hence the following rule of the guiding points: "The surgeon should not at the commencement occupy himself with looking for the artery, but should seek the first marked point of guidance, then the second, then the third, and so on to the end."

In looking for the sheath every anatomical guide is to be made use of to prevent undue manipulation or separation of parts.

When the sheath is found and the pulsating artery is felt within, the end of the operation is not distant. Yet many errors may be committed. Every possible mistake should consequently be thought over beforehand in order to be avoided. The operator must ask himself as to the position of the nerves and veins about the part, so as to avoid them. He need not look for them as in a dissection, for this would necessitate superfluous manipulation, but their existence ought to be present in his mind. He should only remember their relative position to the vessel where the ligature is to be applied, and then guard against their being injured. The sheath having been found, it must be raised by the forceps and carefully opened (Fig. 146, A), such opening being only sufficient to admit a probe or aneurism needle, and the less the sheath is separated from its vessel the better. The needle (Fig. 147) with the ligature is then to be passed (Fig. 146, B), and it should be introduced between the artery and the vein, because when it is passed the other way the vein may be perforated or mistaken for fascia; yet in the hands of a careful surgeon this point need not weigh against convenience. With the exposure of the artery all anxiety ceases, for, to put an ordinary silk, wire, or catgut ligature around it is a comparatively easy task with the majority of arteries; so when this is accomplished, the operation, as such, is all but completed. To do this, however, the surgeon must be careful not to elevate the artery from its bed by the ligature, but to tie the knot with his fingers

with a double ligature (Fig. 144A). The nævus is then
tures tightly drawn beneath the pin; but before the
well to puncture it to let out the serum and blood, to
more perfect strangulation of the growth. When this act
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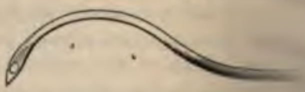
FIG. 145.



The best needle for the application of a subcutane
above.

Richet, "Aneurism," in 'Dict. de Méd. et de Chir. Prat.,'
clopédique des Sciences Médicales,' 1866.—*Broca*, 'Traité
différens Méthodes, &c., pour l'Oblitération des Artères,'
Translation.—*Bellingham*, 'On Aneurism,' 1847.—*Tufnell*,
sion,' 1851.—*Holmes*, 'System of Surgery,' 2d ed., 1870.—
Dr. Norris, 'American Journal.'—*Dr. Stephen Smith*,
1861.—*Wardrop*, 'Cyclop. of Surgery.'—*Syme*, 'Observ.
W., 'Med.-Chir. Trans.,' vol. xl.—*Dr. Jones*, 'On Hemorrh

THE LIGATURE OF ARTERIES.—

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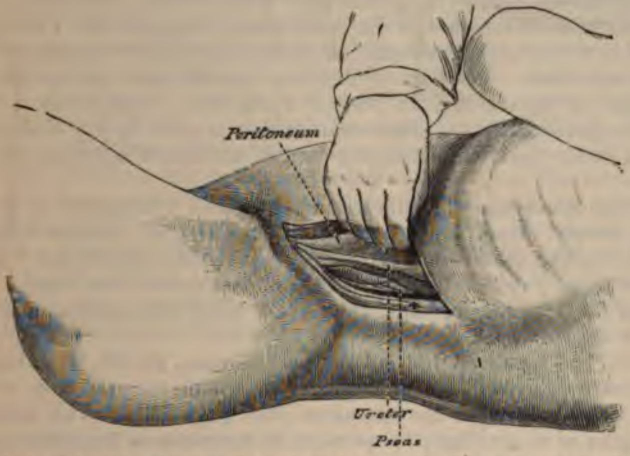
the influence of chlo-
by Dr. Murray,

Newcastle-on-Tyne ('Rapid Cure of Aneurism by Pressure,' 1871), Dr. Heath, of underland ('Brit. Med. Journ.,' 1867, p. 287), Mr. Holden ('St. Barthol. Hosp. Rep.,' 866), Dr. Moxon and Mr. Durham ('Med.-Chir. Trans.,' 1872), and Dr. Greenhow, id., 1873.

I believe, nevertheless, the operation of placing a ligature upon the abdominal aorta to justifiable under exceptional circumstances, such as in cases of aneurism of the common iac artery when all other means are inapplicable.

The best incision by which to reach the abdominal aorta is the *indirect*, a modification f that adopted by Sir P. Crampton in the case of the common iliac artery (Fig. 148), viz., one extending from the anterior superior spinous process of the ilium of the left side to the cartilage of the tenth rib, the peritoneum being reflected. The great difficulty in this operation is in the application of the ligature to the vessel. The best *direct* incision is through the abdominal walls on the vessel such as is practised by Dr. Watson.

Fig. 148.



Incision for the application of a ligature to the aorta or common iliac artery.

Ligature of the Arteria Innominata.

The first operation was by V. Mott, of New York, in 1818, and since then this artery has been tied twelve times, but only once with success (by Dr. Smyth, of New Orleans, in 1864), and in that case the carotid and vertebral arteries were likewise ligatured, the former at the same time as the innominata, the latter a month afterwards for secondary hemorrhage. Dr. Smyth accomplished this on the suggestion made by Mott in 1818, when he wrote, "by thus intercepting the retrograde current through the primitive carotid there would be less chance of any reflux hemorrhage in the event of a phagædenic ulceration taking place in the wound." In all the other cases a fatal result rapidly ensued. It can only be entertained, therefore, in cases of injury to the carotid or subclavian near their origin, or in exceptional cases of disease. When decided on, the operation should be proceeded with as follows:—

Operation.—The head being thrown back to the left and the shoulder depressed, the vessel may be secured by making an incision along the anterior border and sternal origin of the sterno-mastoid muscle; or, by a transverse one over the upper border of the clavicle making its centre correspond to the upper border of the sterno-clavicular joint; or, by both combined. Under all circumstances the sternal and sometimes a part of the clavicular origin of the muscle will require division. The sheath of the cervical vessels will then come into view, with the internal jugular vein on the outer side of the carotid artery and the vagus nerve between them. On tracing these downwards the innominate vessel will be reached. In a healthy subject the artery is always to be found behind the right sterno-clavicular joint, but in disease, its relative position may be altered by mechanical displacement. Dr. Cooper, of San Francisco, has reached the artery on two occasions by removing the sterno-clavicular articulation.

In **aneurism of the innominate** there is no possibility of applying a ligature to its cardiac side, even if the disease involves *only* the upper part of the artery; yet as a rule this form of aneurism is almost sure to be associated with dilatation of the aorta. The distal operation, however, may be thought of, the carotid and subclavian arteries being ligatured simultaneously or consecutively. Of five instances in which the former practice was followed one (Ensor's case, 'Lancet,' July 31, 1875) lived sixty-five days, and one recovered; while out of three of the latter an equal success may be recorded.

The credit of the successful case in the former class, for a success I take it to have been, belongs to Mr. C. Heath, who tied the subclavian artery in the third part of its course as well as the common carotid simultaneously in 1865. The operation was followed by marked relief, and the diminution of the tumor; the woman, æt. 30, survived the operation four years, and died from rupture of the aneurism. After death the aneurism was found to be of the aorta, the innominate being only slightly involved. (*Vide* Prep. in Mus. of Royal Coll. of Surgeons, and 'Path. Trans.,' vol. xxi.)

The successful issue to the case in the latter class belongs to Mr. Fearn, of Derby, who tied the carotid in 1836, and the subclavian in the third part of its course two years later, for innominate aneurism. The patient died four months after the second operation from pleurisy. I had an opportunity in 1866 ('Path. Soc. Trans.,' vol. xviii) of carefully examining and reporting on this preparation which is now in the College of Surgeons' Museum, and a better specimen of a cured small sacculated aneurism could not possibly be seen.

Aneurism of the innominate has likewise been treated by ligature of the subclavian or of the common carotid alone, Wardrop's operation; and in 'Holmes's Surgery' a most interesting list of references to such cases, collected by Mr. Heath, can be found. Out of eighteen, Evans's case, as recorded by Wardrop, was cured; his own lived two years; Morrison's case lived twenty months, two others lived six months, and the remainder lived only a few days or weeks.

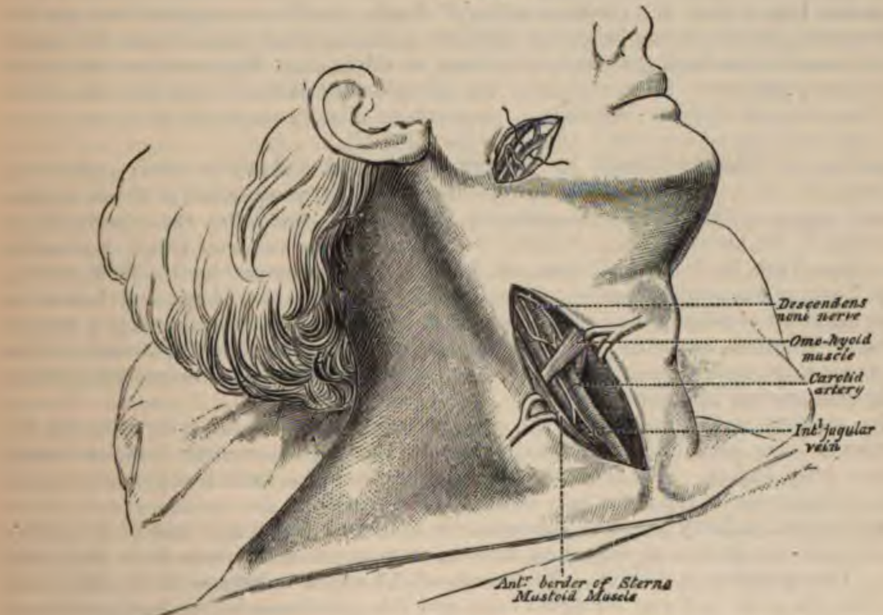
In August, 1871, I ligatured the subclavian in a man, æt. 33, for this affection, and a rapid convalescence followed, with great diminution and consolidation of the aneurism. The man lived three years after the operation (*vide* page 329). This result, therefore, is not so discouraging as to preclude the question of operation in favorable cases. It should only be entertained, however, under exceptional circumstances, and more as a palliative than a curative remedy.

Ligature of the Common Carotid Artery.

This operation was first performed for aneurism by Sir A. Cooper in 1805, but unsuccessfully. The same surgeon, however, had a successful case in 1808, the man surviving thirteen years ('Guy's Hosp. Rep.,' vol. i). The operation may be demanded for aneurism or erectile tumors of the trunk itself or one of its branches, in the orbit, on the scalp, &c., and for wounds or hemorrhage. It may also be called for as a distal operation in aortic aneurism. It is a dangerous and sometimes a difficult operation, but in a moderately thin subject it may be performed with facility. It should only be resorted to when all other means of treatment are inapplicable or have been found ineffectual; for aneurism it ought not to be performed unless the treatment by digital compression has been rejected. Holmes well sums up the matter in his College Lectures, 1873, as follows: "That the experience of surgeons hitherto leads to the conclusion that aneurism of the trunk of the carotid artery may be very often treated successfully by compression, and that the cure by compression frequently leaves the artery unobliterated, and therefore exposes the patient to a far less risk of cerebral mischief than the ligature; that the ligature of the carotid for such tumors is extremely dangerous and ought not to be undertaken until attempts, well devised and perseveringly carried out, have failed to effect the cure by compression; and that when the surgeon has been compelled by the position of the tumor to place his ligature close to the proximal side of the sac, it is worth very great consideration whether it would not be better to evacuate the tumor, and tie the distal part of the artery also; finally, that cases do occur in which Brasdor's method holds out a rational hope of cure, but that this operation ought not to be practised except in cases of growing aneurism, when digital pressure checks the pulsation of the tumor, yet has failed to effect a cure." ('Lancet,' June, 1873.) The vessel may be ligatured in the upper part of its course at the apex of the carotid triangle, in a line with the cricoid cartilage, or, it may be ligatured lower down; the former position is the preferable and more easy, and for disease of any of the branches of the vessel should be selected. The latter should only be resorted to for disease or wound of the upper part of the trunk itself. The course of the artery can always be made out, corresponding as it does with a line drawn from the sterno-clavicular joint to the angle of the jaw; it divides at a line on a level with the upper part of the thyroid cartilage, and should be tied opposite the cricoid. The centre of the incision should consequently correspond to this point, and should extend about three inches along the anterior margin of the sterno-mastoid muscle. The position of the patient should therefore be such as to render this muscle prominent, which is insured by the extension of the head backwards, the face being turned to the opposite side.

Before making the first incision through the skin, platysma, and superficial fascia, the surgeon should assure himself that no large vein, such as the anterior jugular, is likely to be divided; gentle pressure below, enough to interfere with the venous circulation of the part, readily supplies this information. The deep fascia covering in the sheath of the vessel may then be divided, care being taken to do this to the whole extent of the external wound. The sheath of the artery will then come into view, lying between the trachea and sterno-mastoid muscle; the pulsation of the vessel likewise can be detected. The head of the patient at this stage of the operation should be slightly raised, so as to relax the sterno-mastoid muscle and allow its being gently drawn out by means of the retractor, as well as to permit of the separation of the cellular connective tissue of the part. The anterior belly of the omo-hyoid muscle will then probably be at once visible with its fibres passing downwards and outwards, and, when this muscle is broad it will cover in a great part of the vessel. The descendens noni nerve may likewise be seen lying upon the sheath, or sometimes within; due care being taken that it is not wounded or included in the ligature; and if it be in the way, it must be gently held aside by a retractor, as also any large vein that crosses the sheath. The inner border of the sheath is then to be taken up and firmly held with forceps, a sufficient opening being made in it by the knife held with its flat surface towards the artery, to allow of the introduction of the aneurism needle; the needle is then generally recommended to be passed *armed*, though this is not a point of importance, while *unarmed* it is passed with greater facility; then by a little manipulation the needle may be passed round the artery from without inwards, introducing it between the vein and vessel, its point being kept close to the artery. The sheath may then be dropped from the forceps, the loop of the ligature seized or the needle threaded, when it should be withdrawn. The surgeon must, however, satisfy himself beforehand that the right vessel had been exposed, and that the vagus nerve is not included. The vessel can now be tied, great care being observed that it is not raised from its bed or manipulated more than is necessary; the knot should be tightened by the index fingers passed well into the wound. The wound should then be adjusted and the patient put to bed, the most perfect quiet being enjoined. The surgeon ought to remember all through

FIG. 149.



(This figure, with many others in this chapter, is based upon those given in Sedillot's work.)

this operation that the jugular vein is on the outer side of the artery, and often overlaps it; while the vagus nerve is behind, and the descendens noni in front (Fig. 149). None of these parts need be looked for, however, so long as care is observed that they are neither wounded nor included in the ligature.

The operation for ligaturing the *lower part of the carotid* is somewhat similar to the above, the operation being more difficult from the vessel being deeper, particularly on the left side. The incision should in this instance extend lower down over the sterno-clavicular articulation. The muscles will also require more retraction, and probably some division. The ligature, when of a permanent nature, will probably separate about the fifteenth day, but occasionally the period will be longer; the less it is disturbed the better, the gentlest traction only being applied to draw it out of the wound. If the discharge be retarded, the ligature may be twisted daily on its own axis, to facilitate its separation, yet this should be done with extreme caution.

Mr. Cock related to me a case, which he authorizes me to quote, in which Mr. Aston Key applied a ligature to the left carotid for aneurism and the man died on the table; indeed dying on the application of the ligature. After death it was found that the right carotid had been previously obliterated, and the operator had, by ligaturing the left, so interfered with the supply of blood to the brain as to cause death. Such a case as this is unique, and deserves a place in the records of our profession.

With respect to the prognosis after this operation, much depends on the object for which it is performed. Dr. Pilz, of Breslau, whose statistics are the most recent ('Langenbeck's Archives,' 1868), makes out that 43 out of every 100 die. He says that of 228 cases in which the operation was performed for hemorrhage, 128, or 56 per cent., were fatal; of 87 for aneurism, 31, or 35 per cent., died; of 142 for tumors, 49, or 34 per cent., died; of 71 for extirpations, 25 died, or nearly 34 per cent.; of 34 for affections of the nervous system, only one died, or 3 per cent.; and of 38 for aneurism, on the distal or Brasdor's method, 25 died, or 65 per cent.

Secondary hemorrhage is a common cause of death, but brain complications are the more frequent—abscess in the brain and atrophic softening from want of arterial supply being the usual form—local gangrene, as it were, of the brain. Brain symptoms in some of their forms also occur frequently after the operation, when death does not take place simply from altered cerebral circulation. Suppuration of the aneurismal sac is not unfrequent; and in a case of my own it was the cause of death.

Ligature of the external or internal carotid artery is rarely performed, the ligature of the common trunk being preferred. In certain wounds of these arteries near their origin, a ligature may, perhaps, be placed upon them, but the uncertainty of the position of the bleeding point renders the ligature of the common trunk preferable. In the 'New York Med. Journal,' January, 1874, a case is recorded by Dr. H. P. Sands, of New York, of successful ligature of the internal carotid artery above and below the bleeding point for secondary hemorrhage occurring ten days after the removal of a cancerous tumor. Cervical aneurism situated on one of the secondary carotids should be diligently treated by compression, and the Hunterian operation only performed when treatment by compression has failed.

If the surgeon is required to tie the external carotid, he may do so by adopting the same rules as have been laid down for the common carotid, although the incision should be made a little higher. The course of the vessel follows the same line as the common carotid, commencing at the upper part of the thyroid cartilage.

The lingual artery has been ligatured for wounds of the tongue and of the artery itself, to check the growth of cancerous tumors, or to arrest hemorrhage from their substance. The operation is difficult. The trunk of the vessel is always to be found at a point *above the great cornu of the hyoid bone*, and this point must be rendered prominent by the head being well drawn over to the sound side. The best incision is horizontal on a level with the hyoid bone, its centre corresponding to the end of the great cornu. The skin and fascia having been divided, the submaxillary gland will become exposed. On hooking this upwards and dividing the border of the mylohyoid muscle the hypoglossal nerve will be seen resting on the hypoglossus muscle. Beneath this muscle and at a lower level than the nerve, the artery will be found. It is in close contact with the tendon of the digastric muscle. The fibres of the hypoglossus will always require division to admit of the ligature to be applied. Fig. 150 illustrates these points.

An excellent paper on this subject, by M. Demarquay, may be referred to ('Gaz. Méd. de Paris,' 1867).

The facial artery is always to be found in the greater part of its course close to the *anterior* border of the masseter muscle, where it is only covered in by skin, platysma, and scia; and, at this part, a transverse or oblique incision at the lower insertion of the muscle will expose the artery, where it can be ligatured (*vide* Fig. 149). It is difficult to understand under what circumstances this operation can be called for, as the artery can be so readily controlled by pressure, an acupressure needle and twisted suture over it being the best form to employ. But where the artery comes off from the external carotid and lies in the submaxillary gland beneath the jaw, it is somewhat deep, and an operation for its ligature by no means easy. I have, however, had only one opportunity of practising this operation, and it was on a lady æt. 25, who was suffering from a cirsoid aneurism of the vessel as it passed through the submaxillary gland. The operation was successful. I saw the case with Dr. Helsham, of Brixton.

The temporal artery can always be found and pressed upon in front of the pinna of the ear, over the zigoma. It lies buried in the dense cellular tissue which exists in this spot beneath the skin and fascia, and can readily be exposed by a vertical or oblique incision an inch long, one-third of an inch in front of the tragus.

The occipital artery can be traced by a line drawn from the mastoid process to the occipital protuberance, and lies beneath the skin and cranial aponeurotic origins of the sterno-mastoid and splenius trachelo-mastoid and digastric muscles, which must be divided to reach the vessel in the deep part of its course. The artery can be felt about the centre of the line mentioned.

Ligature of the Subclavian Artery.

This operation in the *first part* of the vessel's course has been performed twelve times, but never with success. It is an unscientific as well as an unsuccessful operation, and, for disease, it is scarcely a justifiable proceeding, though for a wound it may perhaps be entertained. The incision for the operation would be similar to that for the innominate.

The point usually selected for the application of a ligature to the subclavian is in the *third part* of its course, where the artery emerges from behind the scalenus muscle. This operation may be demanded for aneurism of the axillary artery or for a wounded vessel.

Aneurism may affect the subclavian artery in any part of its course; it may involve the whole of the artery, or be confined to its first or third portion. When situated on the artery to the inner side of the scaleni muscles, it may be mistaken for an innominate or aortic aneurism; or a common aneurism may involve all these vessels on the right side of the body. When affecting the artery external to the scaleni, it is most frequently associated with disease of the axillary artery.

The diagnosis of subclavian aneurism is consequently by no means easy, and is thus referred to by Nélaton:—

"In subclavian aneurism the tumor extends generally externally to the clavicular origin of the sterno-mastoid muscle, reaching the posterior and inferior triangle of the neck; becomes more elongated transversely than vertically; the bruit is propagated more towards the axilla than the neck, and remains the same on compressing the carotid; the radial pulse enfeebled; the limb painful and œdematous, and incommoded in its movements. In carotid aneurism the tumor is seated between the sternal and clavicular origins of the sterno-mastoid muscle, becomes more elongated in a vertical direction than in a transverse one, and on auscultation gives to the ear a *bruit de souffle*, which is propagated more towards the side of the neck than the arm, with diminution of the arterial pulsation in the corresponding side of the face and cranium, and without weakening the radial pulse on the same side. In innominate aneurism the tumor is placed under the sternum, or at the inner border of the sternal portion of the sterno-mastoid muscle, with weakening of the pulse in the subclavian and carotid arteries, and with absence of the other signs peculiar to the two other forms."

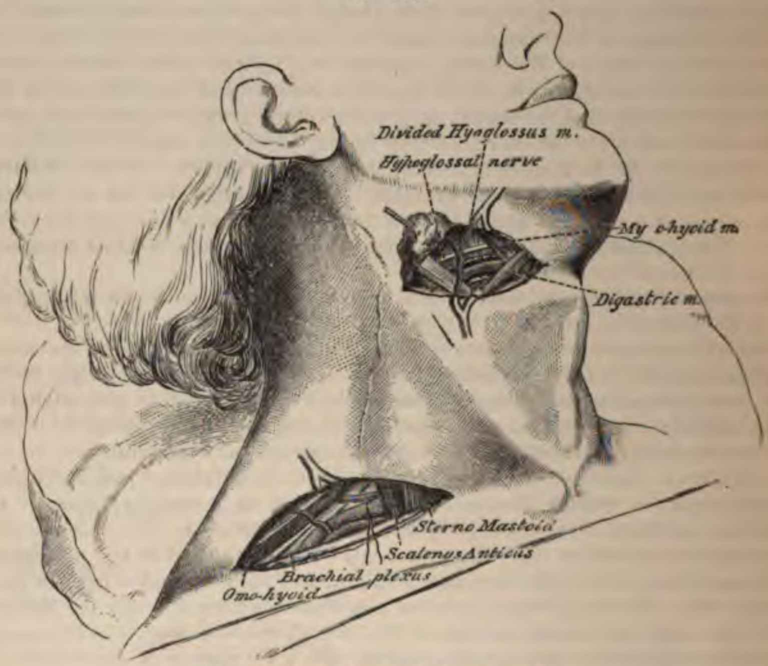
The prognosis must always be regarded as unfavorable, for these aneurisms are peculiarly liable to become diffused even in the early stage of their development as a visible tumor; yet there are several instances on record of their slow progress, and, some fortunate examples of their ultimate cure by natural efforts.

The treatment of these aneurisms is most unsatisfactory, the space at the disposal of the surgeon being so limited that he is at a loss to know where he can attack the disease by the few means that are at command. Ligature of the first portion of the subclavian, ligature of the innominate, the distal ligature of the subclavian and axillary arteries, and ligature of the carotid, have all been performed, and, with one exception, been attended with fatal results. The exceptional case is that of Dr. Smyth, of New Orleans, who tied the innominate and carotid, and subsequently the vertebral artery on the fifty-fourth day. It is only in small aneurisms, occupying the third portion of the artery and the commencement of the axillary, that the operation of tying the subclavian external to the scaleni has been successfully performed, and, in some of these instances, the outer fibres of the scalenus anticus muscle have been obliged to be divided.

The amputation at the shoulder-joint on the distal side of the aneurism has been suggested by surgeons for the cure of the disease. It has too been successfully performed by Professor Spence, of Edinburgh.

Galvano-puncture has been successful in one case by Abeille; and *escharotics* in another by Bonnet. *Manipulation* has been employed by Fergusson in two cases, and by Lidell in one case, with satisfactory results in the latter one only. A case of Porter's may also be accepted as successful. *Direct compression* of the aneurism has been tried by Warren with a favorable issue, although much danger was risked in the proceeding. Conner's case ('Med.-Chir. Trans.,' vol. lii), though one not actually of the same kind, was a very good instance of the value of preventing an aneurism from enlarging, and exerting such moderate compression as to incite fibrinous deposition in the interior of the sac. Poland's case of successful *pressure on the artery* on the cardiac side of the aneurism is quite exceptional. Gay also has recently met with success. The use of *acupressure* by Porter, though successful on the distal side of the aneurism, proved fatal when applied on the cardiac side to the innominate artery, and *injection into the sac* was performed in one case with a fatal result. Langenbeck has recently injected the parts over the aneurism with a *solution of ergotin*, the object being to cause contraction of the aneurismal sac. Such is a list of the means which have been resorted to, but the success has never been great. The question naturally arises, therefore, whether we should not discard such measures, and treat these aneurisms on the ordinary principles of internal aneurisms, by rest, attention to diet, and medicinal remedies.

FIG. 150.



Ligature of subclavian and lingual arteries.

Mr. Poland, in an admirable essay in the 'Guy's Reports' for 1870, gives a very favorable return of cases which he has been able to collect in reference to this point. It stands thus:—

Out of 13 that underwent *general and local treatment* 7 recovered, 1 was relieved, and 5 died; out of 22 cases in which an expectant treatment only was pursued, 4 recovered and 18 died; thereby giving a total of 11 recoveries and 23 deaths, 1 being relieved. Of the 23 fatal cases, the duration of life was noticed in 17.

In 21 cases in which the subclavian artery was ligatured in the *third part of its course* neurism, 9 recovered (in 6 of these it was the left artery that was ligatured), and 12 : 8 of the deaths were due to hemorrhage, and 4 to brain complications or other ptoms. Poland's facts thus accord well with Koch's, who gives 36 recoveries out of ases, something less than half dying, a success, which is certainly encouraging to ce surgeons to undertake the operation.

'he operation.—It has been already stated that the application of a ligature to the clavian in the first part of its course is scarcely a justifiable operation; but when undern, the incision on the right side would be similar to that for the innominate; on the side it is scarcely practicable on account of the depth and relation of the artery.

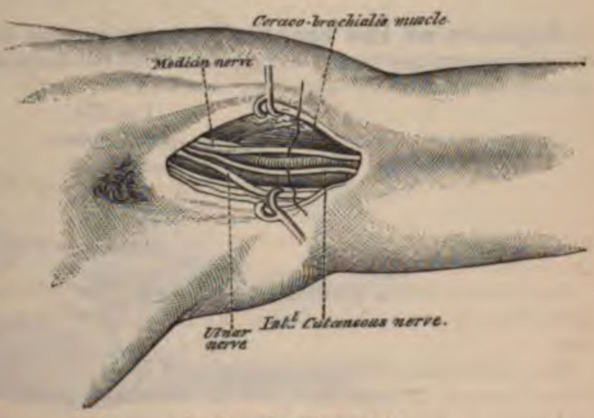
n the *third part* of its course the operation should be performed as follows (the method g similar for both sides). The patient should be raised on a pillow with his head wn back and face turned to the opposite side, an assistant drawing the arm down as h as possible to depress the shoulder. An incision three or four inches long should be made on the upper surface of the middle of the clavicle (Fig. 150); not above the , as the external jugular vein might then be wounded. Some surgeons advise the to be drawn down from the neck upon the clavicle, so as to diminish this risk. In ncision the skin with the superficial fascia and platysma will be divided. The deep is then seen with the external jugular vein coursing over it. This must be held with a retractor. When its division is a necessity, it should be done after the cation of two ligatures, one above and another below the line of section. The cerfascia can then be divided the whole extent of the wound, which must be done with on a director; and should more room be wanted, a portion of the sterno-mastoid or zius muscle may be divided. The knife is now to be laid aside and the artery looked n the space exposed, the parts being separated by a director or the handle of the el. The vessel will be found just on the outer side of the scalenus anticus muscle edge of which can generally be felt) and behind the tubercle on the first rib, a point n can almost always be made out. Several arteries of large size will probably be l crossing this space, as well as many veins. The supra-scapular artery and vein lways be seen behind the clavicle. The brachial plexus lies above and behind the avian artery, the subclavian vein in front and below. When the vessel is seen or he sheath is to be opened and the aneurism needle passed around it from above wards, care being taken not to injure the vein or include a nerve.

LIGATURE OF THE AXILLARY ARTERY.

is is a rare operation, although it may be demanded for some wound of the vessel, r aneurism of the brachial. It may be performed in two positions, either imme- ly below the clavicle, or, in the axilla.

he subclavicular operation is carried out by an incision made immediately the bone from the coracoid process to its sternal end, dividing integument and , yet carefully avoiding the cephalic vein that runs along the anterior border of the id to join the axillary. The cular origin of the pectoral le may then be divided, the deep fascia or costooid membrane covering in heaths of the vessels will xposed and divided. In step of the operation, some e branches of the thoracic nial artery will come into , and if wounded, must be ed. The coracoid inserof the pectoralis minor lso be seen. The fascia ing in the vessels will then xposed, and on laying it the greatest care is neces- as the axillary vein lies diately beneath it, while will be found the vessel g on the first intercostal muscle. The brachial plexus is above and behind. The ry vein should be drawn downwards and the aneurism needle passed from below

FIG. 151.



Ligature of axillary artery.

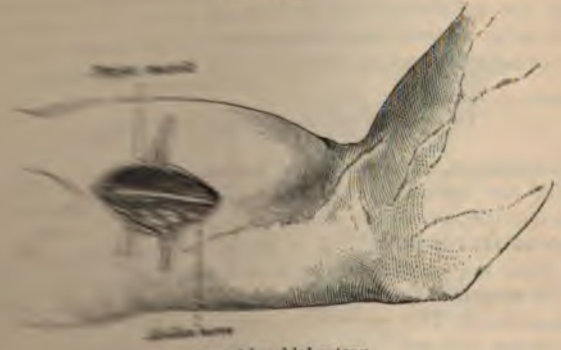
[illegible] external respiratory nerve of Bell that passes [illegible] exposed, the passage of the ligature will [illegible] the side of the body. On the dead subject this [illegible] veins and arteries that exist in the space [illegible] far from easy.

[illegible] **in the axilla,** the arm should be well raised [illegible] slightly posterior to the middle line of [illegible] along the inner margin of the coraco- [illegible] about two or three inches, and the deep [illegible] divided to the whole extent of the wound, when [illegible] will come into view. In this stage of the [illegible] the arm to relax the parts. The vessel, as a [illegible] nearer to the pectoralis major muscle, and [illegible] The internal cutaneous nerve is in front.

[illegible] operation altogether, and advised the surgeon [illegible] inches long, carried upwards along its course, [illegible] muscle; yet few have followed this advice, [illegible] named subclavicular, one of its modifications, or [illegible] for the superior operation prefers an incision [illegible] downwards in the course of the vessel to the middle [illegible] incision necessitating the division of the great pec- [illegible] He says "that this division need not leave any [illegible] by proper position ready union may be effected [illegible]

[illegible] artery, the surgeon must ever be on the outlook [illegible] of the vessel.

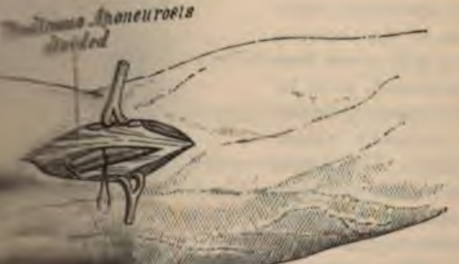
FIG. 152.



Ligature of brachial artery.

[illegible] **artery** may be demanded for direct injury to the [illegible] one of its divisions in the hand or forearm which

FIG. 153.



Ligature of brachial artery.

[illegible] &c., and can be performed readily in any part of its [illegible] the best point to choose. The course of the vessel is

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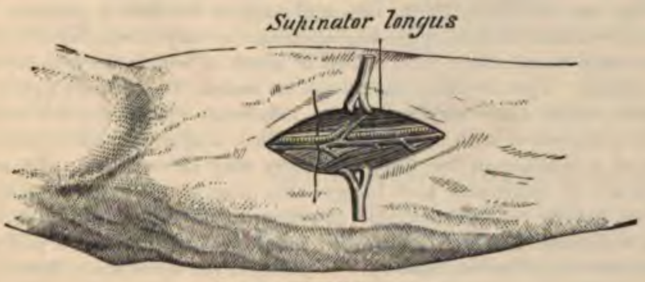
sures,
attention
Mr.
able
thus:—
Out of
5 died;
and 18 died;
the 23 fatal
In 21 cases

indicated by a line drawn from the middle of the axilla to the inner side of the biceps tendon at the bend of the elbow, while the inner border of the biceps muscle is the guide to the incision. The vessel may be exposed by a cut, two to three inches long, made in this position, with the arm extended and supinated. The skin, which is always thin, and the fascia should be carefully divided, and the deep fascia which is thus exposed ought then to be laid open, but with care, for the basilic vein lies immediately below it on the inner side of the brachial artery. The ulnar nerve will be found on the inner side of the vein, and the median in front of the artery, but there is no regularity in these relations; consequently much care is required in finding the vessel and discretion in tying it, for a high division of the vessel or the existence of some vas aberrans may mislead and confuse. When the right vessel has been found, the application of a ligature is readily concluded. In performing this operation care must be taken not to open the sheath of the biceps muscle, and it should be remembered to flex the forearm on the arm, after the division of the deep fascia has taken place. In several cases in which the occlusion of this artery was required, I have divided it and torsed both ends with excellent results.

Ligature of the brachial in its lower third is now rarely performed. In the days of bleeding, it was by no means unfrequently required for traumatic aneurism, though it has never fallen to my lot to witness its performance for such a cause. The operation may be performed with the forearm extended, by making an incision two and a half inches long on the inner side of the tendon of the biceps, care being taken to avoid the large veins that ramify in the superficial fascia. The tendinous aponeurosis of the biceps will then come into view, and, on its division, the artery will be exposed with its venæ comites—the tendon of the biceps being on its outer and the median nerve on its inner side. The forearm should then be flexed after the artery has been exposed, when a ligature can be passed without trouble.

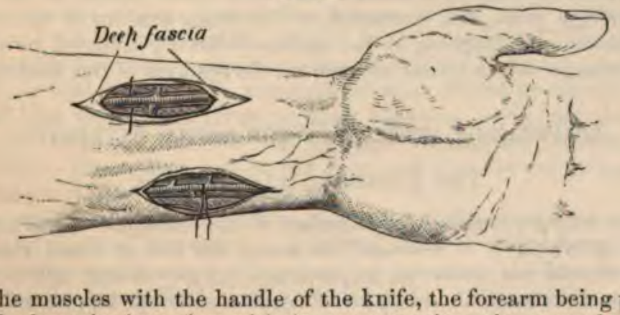
Ligature of the radial artery.—A line drawn from the *outer* side of the biceps tendon, at the bend of the elbow to half an inch internal to the styloid process of the radius at the wrist, marks out with sufficient clearness, the course of the radial artery, and the vessel may be tied in any part of it. In the upper third of the forearm (Fig. 154), between the supinator longus on the outer and pronator teres on the inner side, it can be found by an incision two inches long made in the line above mentioned, dividing the integument and deep fascia, care being taken not to divide the large cutaneous veins unnecessarily.

Fig. 154.



Ligature of radial artery.

Fig. 155.



On separating the muscles with the handle of the knife, the forearm being partially flexed, the artery will be brought into view with its venæ comites, the nerve being to its outer side. A ligature can then be easily passed round the vessel. I have had to cut down upon the radial artery in this part of its course for a traumatic aneurism the result of a punctured wound, when I divided the vessel and twisted both ends, convalescence speedily following.

At the lower third the vessel may be found external to the flexor carpi radialis muscle, but internal to the supinator longus. It lies beneath the deep fascia, and, on the division of this, the artery can readily be found (Fig. 155). On the dead subject, the principal cause of difficulty in applying the ligature lies in the fact, that students look for the artery too superficially, mistaking the superficial radial vein for the deep. I have had to ligature or twist the radial above the wrist on seven occasions for aneurism; in six for traumatic aneurism situated in front of the wrist, and in the other for aneurism on its dorsal end. In all a good result ensued.

Ligature of the ulnar artery.—This vessel lies beneath the superficial layer of muscles in the upper half of its course, and, in the lower, it is found between the tendons of the flexor carpi ulnaris on the inner side and flexor sublimis digitorum on the outer, being covered with integument and deep fascia. Its position is roughly indicated by a line drawn from the inner side of the biceps tendon to the radial side of the pisiform bone, the upper part of the vessel describing a curve with the concavity outwards.

To ligature the artery in the upper half of its course, an oblique incision must be made crossing the line above indicated, and the radial border of the flexor carpi ulnaris should be found. Through this the incision must be made, when the artery will be seen between the two layers of muscles. This operation is very difficult and uncertain, and it is an open question whether it ought to be performed. I am disposed to think that the brachial under all circumstances ought to be tied rather than have recourse to it.

To tie the ulnar above the wrist is not more difficult than to tie the radial (Fig. 155). An incision along the outer side of the flexor carpi ulnaris, dividing skin, superficial and *deep* fascia, exposes the vessel, with its venæ comites, and the nerves on its inner side. A ligature can easily be passed round it. The drawings well illustrate these points.

Hemorrhage from the palm of the hand is always alarming and troublesome, more particularly from a punctured wound. In a superficial incised wound the vessel may generally be found and ligatured or twisted, but, in the case of a deep wound, it is neither expedient nor justifiable to cut into and explore for such a purpose.

When the vessel cannot be tied, a graduated compress may be applied over the wound and the fingers flexed and bound down over a ball or block of wood, the arm being well raised in a vertical position. This dressing should not be undone for at least five or six days. If these means fail, which they rarely do when efficiently employed, the radial and ulnar arteries may be compressed with acupressure needles, and should this prove unsuccessful, the application of a ligature to the brachial artery may be required. In neglected cases where the parts are all infiltrated and boggy, this practice may be called for at once. It is well, however, before resorting to this practice, to try extreme flexion of the forearm upon the arm, with forced supination of the hand, with or without a pad at the bend of the arm; as it is now well known, that by this position the circulation through the brachial artery can be completely arrested; indeed, under all circumstances, whether for injury or disease of the arteries of the hand and forearm in which surgical interference is requisite, it would be well to remember this treatment, it being most effective. It should be known, however, that repeated hemorrhage may take place from the palm of the hand from the presence of a sloughing tendon. In illustration of this I may mention a very interesting case I had with Dr. Bunny, of Newbury, where a gentleman, æt. 33, had his middle finger bent back so forcibly by a cricket ball as to cause rupture of the integument in front of the extreme joint, and laceration of the flexor tendons of the finger about the wrist. Suppuration and sloughing of the tendons followed, attended by repeated attacks of palmar hemorrhage, which ceased at once on the removal of the dead tendons.

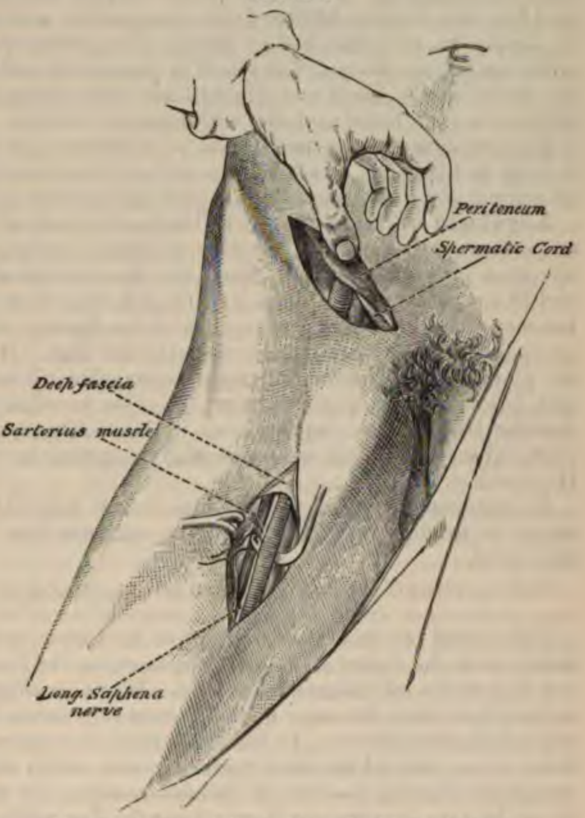
LIGATURE OF ARTERIES OF THE LOWER EXTREMITY.

The External Iliac Artery.

This operation may be required for aneurism of the common femoral artery, or for any other affection in which it is necessary to arrest the flow of blood through the lower extremity. It should not, however, be performed for any disease unless pressure of the artery, digital or instrumental, has proved ineffectual or is inapplicable, for Mapother ('Dub. Med. Press,' 1865), Eck ('St. Barthol. Hosp. Rep.,' 1866), and Hilton ('Med.-Chir. Trans.,' 1869) have all recorded instances of cure of inguinal aneurism by these means. The operation of ligature is, however, a successful one, and Norris and Cutter give forty-seven fatal cases out of 153 ('Am. Jour. Med. Sci.,' 1847 and 1864). I have performed it on six occasions, and in all with success. The course of the vessel is clearly indicated by a line drawn from the left side of the navel where the aorta bifurcates, to the middle of Poupart's ligament—the upper third of this line corresponding to the common iliac, and the lower two-thirds to the external.

Abernethy, in 1796, was the first to ligature the vessel. The incision he practised was vertical in the course of the artery, beginning an inch above Poupart's ligament. The peritoneum, however, is too much disturbed by this proceeding, as well as the abdominal walls weakened. The best incision is that employed by Sir A. Cooper, a slightly curved one, about half an inch above Poupart's ligament, and to the inner side of its centre, curving upwards and outwards for about three inches towards the anterior superior spine of the ilium. (Fig. 156.) This incision should divide all the soft parts superficial to the external oblique muscle. All vessels that are divided should be secured.

FIG. 156.



Ligature of external iliac and superficial femoral arteries.

The tendon of the external oblique muscle should then be divided the whole length of the skin wound, together with the internal oblique and transversalis muscle when they cannot be drawn outwards, and care should be taken not to injure the peritoneum; the cord which then comes into view should be drawn inwards and the parts held well aside by hooked retractors. With the fingers, the transversalis fascia should be torn through from Poupart's ligament, the peritoneum raised upwards, and the sheath of the vessel exposed, the vein being to the inner side of the artery. By means of a director and forceps, the sheath can readily be opened and a ligature passed, the needle being introduced between the vein and artery. To divide the transversalis fascia, the whole length of the wound, is an unnecessary and dangerous proceeding; but to deal with it as suggested above is an extra protection to the peritoneum, and in no way renders the operation more difficult; indeed, I have been led to believe, that it facilitates the operation. It certainly does this on the dead subject, and in the six cases in which I have been called upon to perform it on the living this opinion was confirmed. The genito-crural nerve, which lies upon the vessel, should not be included in the ligature. The operation, however, is only applicable for tumors situated below Poupart's ligament; for others, Abernethy's operation, or that suggested for the common iliac, should be selected.

Ligature of the common iliac artery has been performed about thirty-nine times, and only ten times with success. It was first successfully performed by Mott, of New York, in 1827. I have seen it done but once, and then by my colleague Mr. Cock in 1863, on a man æt. 27, and also with success.

To expose the vessel, the incision must be long, its length being determined by the size of the aneurism and depth of the artery. A curved incision commencing outside the internal ring and passing upwards and outwards as for the external iliac artery, appears to be the best, the muscles being divided to an equal extent. The transversalis fascia must be laid open or torn through and the peritoneum turned upwards. It is at this part of the operation that the greatest difficulties arise, for as soon as the transversalis fascia is divided, the peritoneum covering the intestine bulges into the wound. This membrane also is frequently found adhering to the aneurismal sac, and much difficulty is felt in separating it. This was markedly so in Mr. Cock's case. The oozing of blood into the wound also masks the vessel. The depth of the wound, likewise, renders the application of the ligature a matter of great difficulty. Nevertheless, these difficulties can be overcome by care and good aids. The operation is similar to that last described, though more difficult. In 1846, Mr. Stanley ligatured the common iliac artery by an operation suggested by Sir P. Crampton, and described by Skey.—The patient was placed upon his side, and an incision made from the end of the last rib downwards and forwards in front of the iliac crest, the transversalis fascia was divided, and the peritoneum rolled up. The common iliac artery was then found and tied with apparent facility. On the dead body, this operation is far from difficult, and promises to be of service to the living when the aneurismal tumor is large and high up. Indeed, it is probably the better operation of the two given. The abdominal aorta too, could be ligatured by the same means. (Fig. 148, page 341.)

Ligature of the internal iliac.—Stevens, of Vera Cruz, in 1812, was the first to perform this operation in a case of gluteal aneurism, occurring in a negress, and the operation proved successful. Since his time, the operation has been repeated eleven times, and in six with success. The incision and steps of the operation are the same as for the common iliac. Stevens, however, cut down through the anterior abdominal walls, similar to Abernethy's operation for the external iliac. It should not, however, be performed for gluteal aneurisms unless rapidly increasing till other means of cure have been tried and failed, such as pressure upon the aorta or common iliac, or even galvano-puncture. Besides Holmes has clearly shown in his College lectures, that in cases of imperfect or ruptured sacs, either the operation of Anel or that in which the sac itself is opened should be practised.

In operating upon any of the iliac vessels it should be remembered that great variety exists as to their length. When the common iliac is long, its branches are short, and *vice versâ.*

LIGATURE OF THE FEMORAL ARTERY.

This vessel can be tied in any part of its course, and when the thigh is straight, a line drawn from the centre of Poupart's ligament to the centre of the popliteal space, will mark out its position with tolerable accuracy. When the thigh is abducted and rotated outwards, a line drawn from the same point above to the inner side of the inner condyle indicates the upper half of its course. In the upper third, it is tolerably superficial; in the middle and lower, it is covered by the sartorius muscle, which varies much in its width, and by the membrane forming the roof of Hunter's canal. At the present day, it is an exceptional act to ligature the vessel in Hunter's canal. For popliteal aneurism, the artery is generally ligatured in the middle third of its course, at the apex of Scarpa's triangle. For aneurism of the femoral itself, the common femoral may be tied below Poupart's ligament.

The **Common Femoral** is usually about an inch and a half in length, it does not exceed one inch in one case in four; while in one in four it is between an inch and a half and two inches. (Nunn.) It is from these facts that surgeons have generally preferred to ligature the external iliac rather than the common femoral. The two Porters, however, as well as Macnamara, of Dublin, have adduced sufficient evidence to prove that success may attend the practice, giving thirteen cases between them, and eleven proving successful. On the other hand, Erichsen tells us that out of twelve cases on record, three only succeeded—having evidently overlooked the Dublin cases. He states also as his opinion that the operation "ought to be banished from surgery." But with that I cannot agree, after a careful perusal of the Dublin cases in the 'Dublin Quart. Journ.,' 1860, and 'Brit. Med. Journ.,' Oct., 1867.

The operation, moreover, is not difficult; the vessel being readily exposed by a vertical, oblique, or transverse (Porter's) incision. The sheath of the artery is then to be opened without touching the vein—indeed, the vein should never be exposed—care being taken not to inclose the crural branch of the genito-crural nerve running down in front of the vessel, in the ligature.

The main arguments against the operation are founded on the uncertain length of the artery, the proximity of the ligature to large branches, and the liability to gangrene from the occlusion of the main nutrient arteries of the limb. On the other hand, there is the success of the operation, and the facility with which it can be performed. More experience, however, is required before the operation can be recommended, though it should not be dismissed without due consideration.

Ligature of the femoral artery in the middle third of its course is a capital operation, and, moreover, a successful one. Norris gives 46 fatal out of 188 operations for aneurism or one-fourth of the cases collected from all sources, from John Hunter's first operation in 1785 down to 1848, and undertaken too under many different conditions. Syme informs us that he has had 23 successful cases consecutively, and at Guy's Hospital during fourteen years, the femoral artery was tied for aneurism 24 times, with only 1 death from pyæmia, and one failure, these cases including 6 in which pressure had been tried and failed. Pressure had been employed in 17, and in 11 with success. Mr. Holmes, in his lectures at the Royal College of Surgeons in 1874, moreover, gives some statistics of recent hospital practice, which possibly places the operation in even a better light, inasmuch as out of 77 cases of popliteal aneurism treated by ligature at once, the deaths were 11, or 14 per cent., and the failures 15, or 19 per cent.; while in 44 other cases in which the ligature was applied after the treatment by pressure had failed, 31 succeeded and 13 failed, or 29 per cent., the mortality in the latter class of cases, as might have been expected, being larger than in the former.

I may add, that of 124 cases of popliteal aneurism collected by Mr. Holmes, pressure succeeded in 66, and failed in 58. In 44 of the 58 cases the artery was tied, as seen above, 13 of these dying; and of the remaining 14, amputation was practised in 8, death occurred in 1, while in 4 there was no evidence of subsequent treatment.

The operation.—To tie the vessel, the limb of the patient should be slightly abducted and rotated outwards; the leg being partially flexed and the knee supported on a pillow. The line of the vessel should then be marked by the eye, and the point at which the ligature is to be applied determined, the lower part of Scarpa's triangle being the "point of selection." (Fig. 156.) An incision about three inches in length must then be made parallel to the vessel dividing the integument and superficial fascia down to the deep parts; the course of the superficial veins having previously been ascertained by making pressure upon the saphena vein where it joins the deep femoral, in order to avoid it. If the vein be in the way, the incision can be made by its side, but generally it is on the inner side of the wound. The deep fascia may then be divided, and the *inner* border of the main guide to the artery, the Sartorius muscle, looked for. This is readily recognizable by the course of its fibres *downwards* and *inwards*, and underneath this the sheath of the vessel is certain to be found. The muscle having then been gently separated from its attachments by means of the finger and held *outwards* with a retractor, the sheath will be exposed with the artery in front and vein behind, the long saphenous nerve generally, and sometimes a nerve to the vastus internus, lying upon the vessel. The sheath should then be opened with caution and its inner side held tense, an opening being made sufficient to expose the vessel and admit the aneurism needle; moreover care should be taken to keep the end of the needle close to the artery, in order that the vein may not be injured or included in the ligature. The needle ought to be passed from within outwards. The ligature having been passed, the surgeon must satisfy himself that nothing but the artery is surrounded, and that the right vessel has been exposed; he may then tie it, readjust the parts, and close the wound, covering the limb with cotton wool and raising it on a pillow. Should the vein be wounded by the needle, the artery must not be tied at the point corresponding to the wound but about an inch higher or lower, for "the thread would be left in the vein to act as a seton, and phlebitis could hardly fail to ensue, and would most likely prove fatal." (Holmes.) The wound in the vein should be closed by a fine ligature.

A ligature may separate from the femoral artery in nine or ten, or not even for thirty days, a wide difference existing on this point—an analysis of cases decisively proving that no general rule can be laid down as to when its separation may be expected.

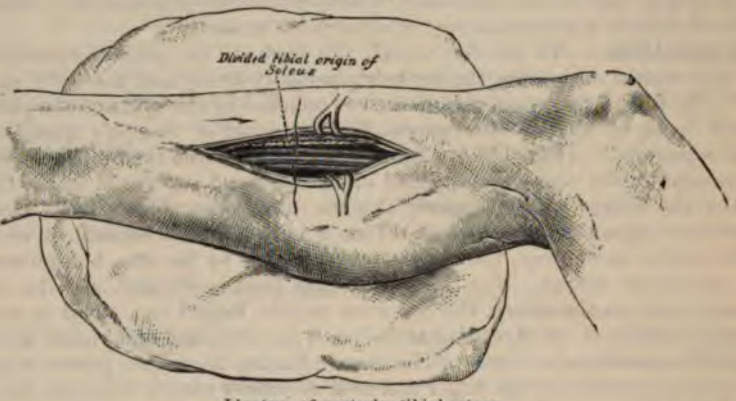
LIGATURE OF THE POPLITEAL ARTERY.

I hardly know under what circumstances the *popliteal artery* may require the application of a ligature, except for a wound; as for rupture of an artery, or for aneurism the operation is as inapplicable as it would be unsuccessful. Mr. Poland has pointed out how the posterior ligament of the knee-joint is frequently involved in the laceration of the vessel. Some years ago I was called upon to cut down upon a large needle that had perforated the popliteal space, and become lost in its tissues; all movements of the joint being impossible by the pricking pain of its presence. I discovered the foreign body lying obliquely across the popliteal artery with its point fixed in the posterior ligament of the knee-joint. The artery was exposed without difficulty by an incision made along the outer edge of the semi-membranous muscle, the leg being extended. The vein is more superficial than the artery, and can always be found to its outer side above; the nerve is still more superficial, and above still further out, but it lies over the artery at the back of the knee and to its inner side where covered by gastrocnemius.

LIGATURE OF THE POSTERIOR TIBIAL ARTERY.

Guthrie brought the weight of his great authority to support the recognized practice of tying a wounded vessel at the wounded part, even in the case of the deeply placed posterior tibial and peroneal arteries, and practically carried it out in a supposed wound of the latter vessel by making a free incision through the muscles of the calf of the leg down to the wounded artery. Arnott, also, acting on Guthrie's suggestion, tied the posterior tibial by this method, though neither the report of the case ('Med.-Chir. Trans.,' vol. xxix), nor Mr. Arnott's remarks, are encouraging in any way in favor of its repetition; indeed, modern surgeons have universally rejected the method in favor of that which has now been described.

Fig. 157.

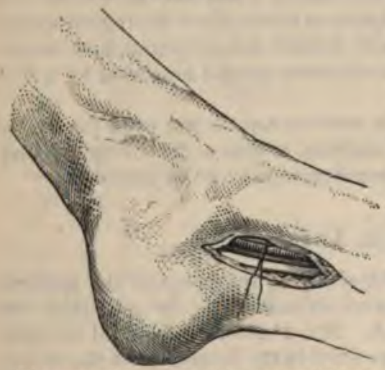


Ligature of posterior tibial artery.

It must be premised that the vessel lies beneath the superficial layer of muscles forming the calf and beneath the deep fascia, the nerve being towards the inner side above, but to its outer side, in the greater part of its course. Its course too is indicated by a line drawn from the centre of the popliteal space to a point midway between the inner malleolus and the tendo Achillis.

In order to tie the artery, the leg must be partially flexed upon the thigh and made to rest upon a pillow on its outer side, the heel being raised to relax the muscles. An incision about four inches in length should then be made about half an inch from the edge of the tibia and parallel with it, through the integument, down to the deep fascia, avoiding, if possible, any large superficial veins. The deep fascia can then be divided and the muscles exposed. The lower border of the tibial origin of the soleus muscle should then be looked for, and beneath it a director introduced; the tibial origin of this muscle should then be divided the whole extent of the wound. The glistening tendinous covering of the deep surface of the muscle is an excellent guide to the vessel, and should not be mistaken for the deep fascia which lies deeper, and beneath which is found the vessel. To search for the artery, the leg must be well flexed, the heel drawn up, and the muscles retracted. The ligature can then be passed in the most convenient way.

Fig. 158.



Ligature of posterior tibial artery behind inner malleolus.

On the dead subject this operation is not difficult, and on the living, more particularly when performed with the aid of Esmarch's bandage, it can hardly be so "difficult, tedious, bloody, and dangerous" as Mr. Guthrie has described, and as is his own operation.

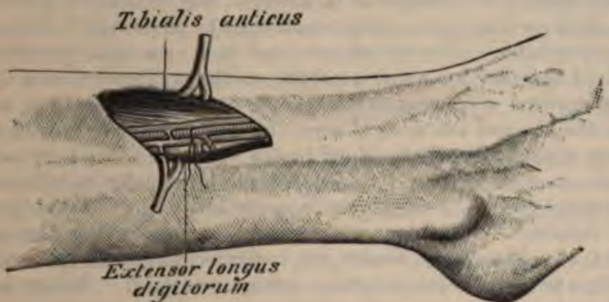
The operator should be careful, however, not to divide the tibial origin of the soleus so near the tibia, as in doing so he may penetrate too deep beneath the deep fascia, and thus lose his best guide, viz., the glistening tendinous tibial origin of the soleus.

To tie the artery at the *lower third of the leg behind the inner malleolus* is a simple operation. It lies with its venæ comites at the junction of the anterior with the middle third of the space between the malleolus and the heel, the nerve being behind. It can readily be exposed by a curved incision two inches long over the course of the vessel, dividing integument and *deep* fascia, which is thick from receiving many fibres from the internal lateral ligament. The relative position of the vessel can easily be seen in the drawing (Fig. 158).

Ligature of the Anterior Tibial Artery.

This operation is far from simple, inasmuch as the vessel lies buried in the upper two thirds of its course between the muscles on the interosseous membrane; its course is indicated by a line drawn from the inner side of the head of the fibula to the base of the great toe. The surgical guide to the vessel is the tibialis anticus muscle, which *lies to its inner side* throughout its course.

Fig. 159.



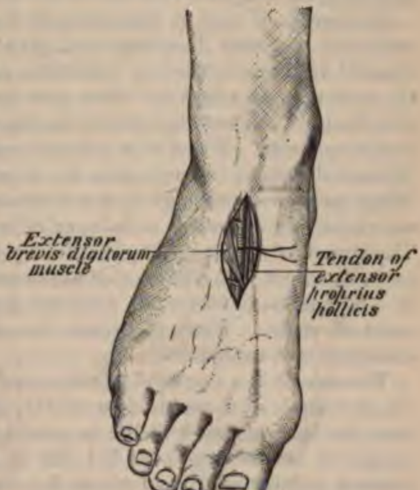
Ligature of the anterior tibial artery.

To reach the vessel in the upper two thirds of its extent it is important to expose the intermuscular space separating this tibial muscle from the extensors communis digitorum and proprius pollicis, and the best way to accomplish this is to make an oblique incision four inches long, commencing at the outer edge of the tibia and directed downwards and outwards towards the external malleolus, dividing the integument and superficial fascia. The deep fascia will then be exposed, and the first white line external to the tibia will be found to mark the intermuscular space outside the tibialis anticus muscle in which the anterior tibial artery is to be found. The fascia over this line may then be opened, and the muscles separated, the foot being well flexed to facilitate this measure. The anterior tibial nerve will then come into view, and beneath it the artery will be found. The ligature may be passed as best can be done.

Ligature of Dorsal Arteries of the Foot.

The dorsalis pedis artery should be ligatured to the outer side of the extensor proprius pollicis muscle, by the side of which it lies. The vessel can readily be exposed by an incision made along its course, the integument and *deep* fascia being divided. (Fig. 160.) It is crossed at its lower part by the tendon of the extensor brevis digitorum muscle, and the nerve lies outside the vessel, while venæ comites attend the artery. The tendon of the

Fig. 160.


Extensor brevis digitorum muscle
Tendon of extensor proprius pollicis

Ligature of dorsalis pedis artery.

last-named muscle is an infallible guide to the artery, as it crosses it, while the tendon of the extensor proprius pollicis muscle is the guide to the incision. The surface line of this vessel extends from the middle of the joint of the ankle to the base of the first metatarsal space.

CHAPTER XI.

INJURIES AND DISEASES OF THE VEINS.

THE blood from a wounded vein is black, flows in a steady stream, and never jets out as from an artery. When mixed with arterial blood, as occurs when both artery and vein are punctured, it appears as a dark band, streaming through a red, or *vice versâ;* the relative thickness of the black or red band indicating the extent of the wound in the artery and vein. Pressure on the distal side of a wounded vein controls bleeding, whilst pressure on the cardiac side increases it.

Wounds of veins unite as do wounds of arteries, the reparative process being alike in both. After a clean incision into a vein repair may be so perfect in a few days as to leave no trace of injury behind. The lips of a wound in a vein readily unite—as after venesection, when kept together by gentle pressure, or the application of a ligature.

A completely divided vein contracts, though somewhat less than an artery; it also *retracts* into its sheath, and the natural arrest of hemorrhage is helped by these actions, together with the coagulation of the blood in the vein and around its orifice. But these processes are slow in their action, very feeble, and practically insufficient. Fortunately, however, hemorrhage from a divided vein is easily arrested by well-adjusted pressure and by elevation of the limb. After amputations, if venous bleeding persist on the removal of the tourniquet, and, should the means just indicated have failed, the bleeding vein may be acupressed, ligatured, or, what is better, twisted, to stop it. When deep veins of large size are divided and cannot be treated, a fatal result rapidly ensues.

A partially divided vein often gives much trouble, although not when *superficial*, because the elevation of the limb, and a compress carefully strapped or bandaged over the wounded part are generally sufficient to check the bleeding, and in three or four days, repair may fairly be expected.

Wounds of deep veins, however, are of grave importance, for they may be so situated that pressure cannot be applied, or, bleeding may be so profuse as to cause speedy death; and further, unhealthy inflammation of the vein may follow with all its dangers.

In wounds of any of the veins of the extremities well-applied pressure is, as a rule, sufficient to arrest bleeding, and give time for repair, although when the trunk of the femoral vein is wounded in operation, as in ligature of the femoral artery, the opening in the vein may be taken up, when it is in view, with a pair of forceps and tied with a fine silk ligature. The same should be done to a punctured wound of the internal jugular, or any large vein. When this practice cannot be carried out the whole vein must be tied. Wounded veins, indeed, may be treated on the same principle as wounded arteries. When pressure is enough to arrest hemorrhage from a vein, however large, the ligature is not required; but when it fails, or is inapplicable, the ligature may be fearlessly employed. The dread of setting up phlebitis by ligaturing veins is based on prejudice and not on experience; it is doubtless due to the influence of authorities who have pronounced against it. It cannot, however, be disputed that phlebitis occasionally follows the surgical treatment of veins. When it occurs the affection is serious, and takes place only in the enfeebled and cachectic.

Wounds of the *internal jugular and subclavian veins* are as fatal, and probably more so, as wounds of the carotid or subclavian arteries. When the internal jugular is wounded near the base of the skull life is speedily destroyed, and, when near its cardiac end, to the danger of hemorrhage is added that of the introduction of air into the heart. When the internal jugular is divided *above* the clavicle, the orifice remains open; the walls not collapsing as they would at a greater distance, owing to their connections with the deep cervical fascia; reflux bleeding consequently takes place from the cardiac end, and, during some violent inspiratory act, air may be drawn into the circulation and into the heart, causing death. Hence great care is always required in operating about the root of the neck to avoid large veins, and to compress or ligature them when wounded.

When death transpires from primary hemorrhage from the internal jugular it is generally within an hour. I recorded in the 'Trans. of Path. Soc.' in 1857 such a case which occurred in the practice of Mr. Birkett, a second was recorded by Mr. Henry Gray in 'Holmes's Surgery,' and a third by Mr. Samuel Cooper in his 'First Lines of Surgery.'

When death does not supervene from either of these two causes yet it may occur from secondary hemorrhage or from pyæmia.

A vertical incision into the internal jugular vein is not necessarily attended with a fatal hemorrhage. When bleeding occurs it will be recurrent. This was well illustrated in a case recorded by Mr. Woodman, of Exeter ('Brit. Med. Jour.,' 1873), in which the internal jugular vein was ligatured with a successful result.

Coagulation in veins. Adhesive phlebitis.—When a vein was found by the older surgeons obstructed by a fibrinous clot, the suspicion of phlebitis was excited, and, when this clot contained in its centre a "puriform" fluid, the evidence of inflammatory action was considered to be strong. When the clot was more or less adherent to the inner membrane of the vein, and this membrane presented a pink appearance, the evidence was thought to be complete. At the present day, however, none of these phenomena are accepted as true indications of an inflamed vein; as it is known that blood coagulates spontaneously in a wounded, lacerated, or bruised vein from prolonged pressure upon its walls, or inflammatory changes in the parts around, and that even in ill-nourished and cachectic subjects, there is a remarkable tendency for the fibrin of the blood to become deposited upon the serous lining of the veins, either idiopathically from some altered condition of the blood, or on the slightest injury, without the existence of inflammatory action.

The supposed pus found in the centre of the fibrinous mass is known to be made up of the white blood-corpuscles present in all coagula, while the pinkish tint upon the serous lining of the vein is due to the mere imbibition of coloring matter from the blood, and not to inflammatory injection.

A clot once formed in a vein rapidly increases, the stream of blood as it flows over it depositing fresh layers, until the whole calibre of the vein is obstructed; when the process is slow regular layers of fibrin may be seen in section, but when rapid the clotting is irregular. At the extremities of the clot, also, like accretions are deposited; the coagula increase more or less rapidly in all directions and into all branches, till complete obstruction, or THROMBOSIS, takes place. This clotting of blood in the vein becomes arrested only by the blood stream of a junction trunk. These coagula can readily be removed by washing, and when removed, the lining membrane of the vein will generally be found natural and the valves visible. The coat of the veins at times may appear thickened from contraction, but Mr. Callender has shown, that this is not real but only an apparent condition, the coats of the veins readily yielding to pressure under water. In the process of cure sometimes the clot will contract towards one side of the vein, thus allowing the blood to pass and the circulation to become re-established. In rarer cases the blood "may drill for itself a passage through the centre of the clot." Ordinarily, however, a different result takes place, the vein becomes permanently obliterated, the clot and vein ultimately contracting so as to form a firm and shrunken cord. In rare cases, the clot may subsequently organize. Authors have described these as instances of *adhesive phlebitis*. In feeble and cachectic subjects, however, these curative changes cannot take place. The clot instead of organizing will soften and disintegrate, giving place to blood-stained puriform fluid, that may be carried into the pulmonary circulation, and causing a lobular pneumonia such as is found in pyæmia from embolism of the pulmonary artery. This was well illustrated in the following case, extracted from the catalogue of the Guy's Museum, No. 1521^{55}. Jugular vein exhibiting a wound occupying about half its circumference, and situated about half an inch above the subclavian, the neighboring branches showing the effects of phlebitis.—James F—, æt. 30, under Mr. Birkett. He received a stab with a knife in the left side of the neck which wounded the jugular vein; much hemorrhage followed and continued for some days, when symptoms of phlebitis set in, and he died of pneumonia twenty days after the accident. The vein was found to be wounded as seen in the preparation, its coats infiltrated with lymph, and its interior filled with fibrin. The lungs were filled with abscesses.

Results such as these, however, do not occur under all circumstances, but only in the feeble and cachectic, for "the clot when softened is usually shut off in an upward and downward direction by newly added coagula. The softening begins in the coagula last formed, and not, as Virchow states, in those first deposited, for in the advance of the malady the patient's health fails, and the fibrin becomes more and more prone to disintegrate and soften into a puriform fluid." (Callender.) The clot softens also in the centre and not at its periphery, and such cases have been described as examples of *suppurative phlebitis.*

Symptoms.—The most prominent symptom of an obstructed vein is œdema of the parts below the obstruction, some fulness of the superficial veins, local pain and tenderness; constitutional disturbance of variable degrees of severity generally preceding. When superficial veins are involved the symptoms may be chiefly local, but in the case of deep veins, constitutional disturbance is certain sure to accompany local action. Among the superficial veins the saphena of the leg and thigh is most commonly affected, and is often a sequela of a varicose condition. Under these circumstances, the tortuous, dilated, indurated vein becomes a marked object, set as it were in a frame of hardened inflamed skin and cellular tissue. The parts themselves will to a certainty be painful, and the pain and tenderness probably extend up the thigh as far as the groin. Among the deep veins, the common femoral or iliac is more frequently involved than any other, and what is known by a "white leg" is due to this affection; it being an œdema of the leg from an obstruction to the femoral or iliac vein, and is usually the first symptom that attracts attention. Local pain and tenderness, with more or less constitutional disturbance, always, however, accompany the œdema. In some cases the phlebitis is of a very mild character, and then a good result may be anticipated; but in others it is very severe, and in such suppurative changes will probably take place.

It sometimes happens that a limb becomes much enlarged and solid in the deeper but not in the superficial parts, that is, no œdema of the cellular tissue beneath the skin will be present, although the superficial veins may be turgid. The absence of this symptom, however, must not mislead; as it simply indicates that the superficial circulation is efficiently carried on, and that no stagnation exists sufficient to allow of passive serous exudation.

When these cases proceed favorably the swelling will gradually subside, as will also every other symptom, the vein either recovering its normal condition, or the blood finding its way through other channels. When they go unfavorably, suppuration will take place, and if the deep parts are involved, the case assumes a very serious aspect; as a local or a diffused abscess may result (the latter condition being the more common) and then blood poisoning too frequently ensues with its usual consequences.

TREATMENT.—The two great indications for treatment in these cases are (1) *to favor the venous circulation of the part, and* (2) *to improve the general condition of the patient.*

The first can be attained by elevation of the limb, the foot being raised higher than the hip, and, by the application of warmth to the part in the shape of fomentations or cotton wool.

The second can be carried out by the administration of a simple nutritious diet, tonics, such as quinine, bark or iron, and stimulants carefully adjusted to the wants of the individual case.

Pain must be allayed by both local and general means, as poppy fomentations, and the internal use of opium, morphia, or chloral.

Leeching should never be resorted to, nor mercury in any of its forms, as the practice was based on a mistaken pathology, and therefore should be discarded.

When suppuration appears it must be dealt with on ordinary principles, as it is wise, as a rule, to evacuate it as soon as it has declared itself.

GOUTY PHLEBITIS.

Subjects who are gouty from hereditary or acquired causes are likewise liable to *adhesive phlebitis.* Sir J. Paget has well described the affection in his 'Clinical Lectures,' 1875; and Mr. Gay has also written ably upon it ('Lancet,' May 19th, 1877): "In such cases the phlebitis may have no intrinsic characters by which to distinguish it, yet not rarely it has peculiar marks, especially in its symmetry, apparent metastases, and frequent recurrences."

Like other forms of phlebitis is it more common in the lower than in the upper extremities, yet it may be found anywhere. It affects, however, the superficial rather than the deep veins, and often occurs in patches, affecting on one day (for example) a short piece of the saphenous vein, and, the next another piece of the same, some other distant vein, or, a corresponding piece of the opposite vein.

The inflamed portions of vein usually feel hard, and are painful to the touch. The soft parts covering the vein become slightly thickened, and often have a dusky reddish tint. When the deep veins are involved, œdema appears with the well-recognized results of venous obstruction, "the limb becomes big, clumsy, featureless, heavy, and stiff; its skin is cool and may be pale, but more often it has a partial slight livid tint, which might be discerned by comparison with the other limb, and has mottlings from small cutaneous veins visibly distended." The limb thus enlarged feels œdematous throughout; but firm and tight-skinned, not yielding easily to pressure, and not pitting very deeply.

By almost this state alone the disease can sometimes be recognized.

The constitutional symptoms associated with this local affection vary from some slight febrile condition, to those met with in acute gout. Complete recovery may take place in this, as in other forms of phlebitis—the veins becoming pervious in some cases and obstructed in others; the limb reassuming its healthy condition or becoming permanently enlarged, cumbrous, and heavy. The risks of embolism are also the same.

Treatment.—Nothing special can be recommended, as the so-called gout remedies do not appear to have much influence on the local disease. Rest, elevation of the limb, lead lotion to the inflamed vein when superficial, and fomentations when deep, are the chief points to be attended to in the local treatment; as well as a lower diet, abstention from stimulants, and saline drinks in general. When feebleness exists the liquor ammonia in doses of five to ten drops with bark is an excellent remedy, but at others, quinine is called for.

There is, however, another form of phlebitis that must be mentioned, and which is by far the most serious, viz., the *unhealthy diffuse or suppurative phlebitis.* It is an affection of the cellular tissue around the veins, these veins themselves being secondarily involved. It is a species of erysipelatous inflammation of a low type, and it is only found in the feeble and cachectic. It comes after a severe injury to, or operation on, bone, or otherwise; after a slight contusion or a severe wound; it may supervene on the puncture, division, or ligature of a vein, or, chronic suppurative disease more particularly of the bones of the cranium. It occurs also in the puerperal state. Depending upon a vitiated condition of the blood, "we are able to appreciate how it is that the many different forms of phlebitis may follow various dissimilar injuries, and reconcile the frequency of their occurrence after operations involving the venous system. The dangers are not to be looked for when the general condition of the system of the individual is good, and when the walls of the vessels are in a healthy state, but they may be anticipated in enfeebled and broken-down constitutions, more particularly when the coats of the vessels are abnormally changed. Upon such a class of persons operative procedure should, therefore, if possible, be avoided." (Dr. S. W. Gross, 1867.)

The disease shows itself as a purulent infiltration of the cellular tissue surrounding the vein, with a thickening and softening of the coats of the vein itself. As the disease progresses, abscesses form around the vein, whilst the circulation through it is arrested by the formation of coagula in one spot, and a sloughing abscess in another. In superficial veins, such as in the leg, all these changes can be well observed, but in the deep they are difficult to diagnose. In the superficial, the external signs of inflammation are well marked, local redness and brawniness of skin around a dilated, thickened, and tortuous vein being the chief symptoms. As the disease progresses, local abscesses appear in the vein itself, which yield blood and pus on being opened, these contents being, doubtless, broken-down coagula.

The constitutional symptoms vary with the extent and severity of the disease; marked depression of the general powers always being present, while rigors not only usher in the attack, but attend its progress; each one probably indicating some suppurative change. Local pain and sleeplessness are common accompaniments, and in cases that cease to be local and have an infective tendency those known as typhoid symptoms occur. When blood poisoning or pyæmia appears, the symptoms are such as have been described in an early chapter.

On the Presence of Air in Veins.

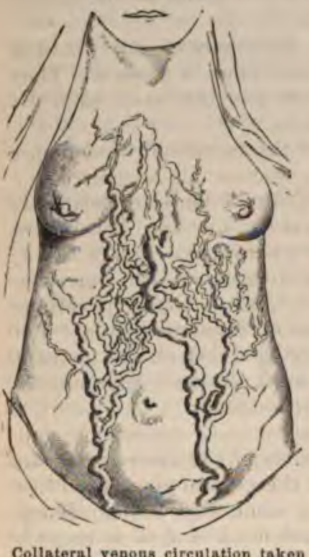
That air may find its way to the heart through an open vein and cause sudden death, is a clinical fact with which all surgeons should be familiar, also that it generally occurs during the removal of tumors about the neck and axilla, amputations at the shoulder-joint, and operations or wounds involving the cervical or other veins. It has likewise occurred in uterine surgery from the injection of air or gas, &c. Two-thirds of the patients affected die from the accident, half within a few minutes, others living hours or a few days. The accident is favored by a thickened state of the vein, and is generally indicated during the progress of an operation by a sudden gurgling, hissing, or bubbling sound in the wound, associated with venous bleeding, sudden faintness and insensibility of the patient, or convulsions, probably terminating in death. When this result does not at once transpire there will be labored and irregular respiration, tumultuous action of the heart and feeble pulse, the lividity of the patient gradually disappearing; the heart then regaining its natural action, and the patient recovering. Bubbles of air may at times be seen in the wound. In some cases, the patient will give a sudden cry with the first onset of the symptoms.

After death, evidence of the admixture of air with the blood has been found, such as bubbles in the vessels of the brain, or in the large venous trunks and arteries. In some cases air has been found in the right cavities of the heart. Where a suspicion of this cause of death exists, the heart and large vessels should be opened under water to make manifest the escape of air-bubbles—one single bubble indicating air in the heart, and many, air in the vessels. Experiments on animals by Erichsen, and by a French commission, tend to confirm this observation.

Treatment.—How to deal with these cases has now to be considered, and, without doubt preventive are more important than curative measures. In dealing with large veins, or, indeed, any veins near their cardiac ends, the surgeon should be careful to apply pressure and to maintain it during the operation; while in some instances it is more expedient to ligature before dividing or twisting them. When the bubbling sound has been heard, pressure must at once be applied to the spot where the bubbles appear. When a large vein has been wounded by accident and its division is not required, the opening must be taken up by forceps and carefully closed with a fine silk ligature. The surgeon should always avoid large veins when it is possible.

When air has been admitted into the heart and its action interfered with, the surgeon's aim should be to keep up its action and help the respiratory act by artificial means such as by cold water on the face and thorax, stimulants, as ammonia to the nostrils, &c. Amussat ascribes recovery in one of his cases to pressure upon the chest, leaving the opening in the vein free, to allow of the escape of the admitted air, but in adopting this practice, care must be observed to close the orifice of the vein in the inspiratory act. Brandy and diffusible stimulants should also be freely given to sustain and stimulate the vital organs.[1]

Fig. 161.



Collateral venous circulation taken from a woman æt. 47 (under the care of Sir W. W. Gull), in whom the inferior vena cava was completely obstructed from cancer. Guy's Hosp. Mus., drawing 44^{40}.

Hypertrophy and atrophy of veins occur in precisely similar circumstances as hypertrophy and atrophy of other structures. Thus, where increase of function of a part exists, or increased growth, the veins will elongate, dilate, and thicken. When decrease of function or disease of a part takes place, the veins waste or become atrophied with other structures. Hence, after amputation of the thigh, the femoral vein becomes as small as the anterior tibial; and, in Mr. Cock's case of arterial varix related in page 333, the vein above the varix withered to a mere cord. On the other hand, in the same case of arterial varix, the popliteal vein below the varix, when taking on the action of an artery, became much enlarged and thickened, in fact hypertrophied, simply on account of the increase of work it had to perform under its new condition; and the superficial cutaneous veins through which the whole of the returning blood must have passed became enormously enlarged. An equally good instance of hypertrophy of veins can be seen when any obstruction occurs to one of the cavæ or any large venous trunk, the venous circulation making its way through other channels, which consequently enlarge. Thus in Fig. 161 the skin veins of the abdomen and chest are seen to be enormously distended and hypertrophied to carry on the circulation from the lower part of the body to the heart; the lower vena cava having been completely obstructed from cancerous disease. The woman, æt. 47, a patient of Sir W. W. Gull, had no œdema of the lower extremities all through the case, thus proving the perfection of the compensatory venous collateral circulation, and probably indicating the gradual progress of the obstruction.

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[1] The reader may refer to an admirable paper on this subject, by Dr. J. S. Green, of Massachusetts, 'Amer. Med. Journ.,' 1864.

Calcareous and atheromatous diseases of the coats of veins may occur, but are rare affections when compared with their frequency in the arteries. In Guy's Museum 1538[25], there is a good specimen of ossified saphena vein, and at St. Thomas's Hospital and the College of Surgeons' Museums may be found examples of calcareous degeneration of other veins. Gay has also described a dissection of a varix which "appears to have been occasioned by disease, originally atheromatous, followed by softening and ulceration of the inner and middle tunics of the vessel;" and Mr. Pick, of St. George's Hosp. ('Path. Trans.,' 1867), has given a somewhat similar example. How far, however, this atheromatous and calcareous degeneration is a distinct disease, or, an "after change in some local deposit of fibrin," is an open question.

VARIX; VARICOSE DISEASE OF THE VEINS AND PHLEBOLITHES.

The term "varicose vein" is unfortunate, as it is applied to any enlarged tortuous vessel, to such as have been already described as hypertrophied veins, and to others that are clearly due to some diseased action resulting in hypertrophy with dilatation. In the sequel the term will be confined to the latter condition. Varix is commonly an affection of the veins in the lower extremities, and mainly, of the branches of the saphena vein. When it involves the submucous vein of the rectum it is called a hæmorrhoid, and, when of the spermatic a variocele. But "all the veins of the body may become varicose," said M. Briquet in 1824. In 1869, a child, æt. 4, was brought to me with a sacculated varix the size of a nut connected with a vein on the outer side of the right forearm: it had been coming on for a year and a half. Taking varix of the lower extremity as a type of the affection, it appears as a disease involving one or more, and in extreme cases all, of the branches of the saphena vein. In most instances it is confined to the larger trunks, and rarely spreads to the smaller tributaries.

In some, however, the affection appears to begin in the capillaries of the skin, and spread towards the larger trunks, and such cases are most common in women. They appear as "clusters of diseased venous radicles" (Gay), and rarely involve other than the smaller branches.

It must not be thought, however, that this affection is one of the superficial veins alone, for such is not the case. Boyer asserted this many years ago, and on his authority, the opinion has been accepted. Verneuil corrected the error, and, in the 'Gazette Hebdomadaire et Médicale, 1855, showed, that varix is as often a disease of the deep veins as of the subcutaneous—the latter often indicating the existence of the former. He believed, moreover, that the intramuscular veins are sometimes affected without the subcutaneous. Hilton and more recently Callender has told us, that the varix of a subcutaneous vein is found wherever the intramuscular veins pass into the subcutaneous, mentioning that "the valves obstruct below, and the column of obstructed, slow-moving blood resists above." He has failed, however, to confirm Verneuil's remarks, that varix of the intramuscular branches is constant.

Mr. Gay, an able author on varicose veins (1868), says, after many dissections, that "with superficial varicosity there are other serious lesions affecting both arteries and veins, deep and superficial, such as would lead to the conclusion that the general circulation has been subject to a very considerable and long-standing embarrassment, some incompetency of the arterial system or impediment to the venous, or both combined;" and these conclusions are probably correct.

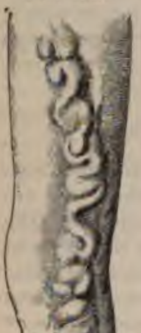
The *causes* of varicose disease of the vein are obscure. Surgeons of the past regarded such affections as the invariable result of some obstruction to the venous circulation, such as prolonged standing, the presence of abdominal or pelvic tumors—pathological, fecal, or fœtal; patients of a relaxed and feeble habit naturally suffering more than the robust; and, in a measure, doubtless their opinions were correct. Mr. Herapath, of Bristol, maintained that the cause of varix was the narrowing of the saphenous opening of the thigh, and cases are on record where its enlargement proved of value; facts, however, are wanting to support this view. General testimony also admits that this disease is as common in the higher as in the lower ranks of life; and in women as in men; that it is as frequent on the right as the left side, and more frequently on both; that it is a disease of the young as much as of the middle-aged; that it is met with in the strong and healthy as well as in the feeble and cachectic; in fact, it is found under every condition of life and in every variety of subject. Some evidence exists that gout and hereditary predisposition are efficient causes, with local injuries and prolonged muscular exertion.

The symptoms vary according to the place of its origin. When it commences in the venous capillaries—its common seat in women—it appears as a fine capillary injection giving an arborescent appearance to the skin, with more or less congestion; and, as it extends, the larger venous trunks become involved, the main trunks being rarely affected.

When it originates in a large trunk, the varix may appear as a fusiform enlargement, or a simple dilatation of the whole length of the vein. In some there will be thinning of the venous coats, in others a thickening, whilst in a third class, one part will appear thin and another thick.

Again the affected vein becomes tortuous and knotted to an extreme degree, and it is far from unusual to find it the diameter of a finger (Fig. 162). The valves of the veins under these circumstances are clearly lost, not, however, from a yielding, due to backward pressure of the column, but from their action being rendered imperfect by the dilatation of the vein behind; the "valve cusps being unable to meet and close the canal shrink and atrophy."

Fig. 162.



Varicose veins. From wax model.

As the disease progresses the tissues around the affected vein become gradually absorbed; the skin is thinned and even the bone grooved; the skin indeed becoming so thin as even to rupture, and, a fatal hemorrhage is far from being a rare rusult. At Guy's during the last few years several cases of this sort have taken place. Subcutaneous rupture of the vein may at times occur, of which I saw a severe instance in a man æt. 62, in 1858. More frequently, however, the soft parts around the diseased vein thicken or inflame. They thicken from a kind of passive exudation into the cellular tissue, the result of impeded venous circulation, and give rise to a slightly anasarcous condition of the part, which in chronic cases becomes somewhat permanent, producing what Liston so well described as a "solid œdema." In extreme instances, this solid œdema is so marked as to give rise to appearances similar to the disease called "elephas," or Arabian elephantiasis.

On the other hand, it is a very common result for the cellular tissue around the vein to inflame, and probably the vein itself. The parts around the varix or tortuous vein become indurated, red, and painful. In healthy subjects this inflammation may end as an adhesive one (local adhesive phlebitis), and in the feeble as a suppurative; local or diffused abscesses subsequently showing themselves. When the powers of the patient are very low, or blood poisoning takes place, that terrible disease, unhealthy suppurative phlebitis, previously described, may ensue.

In the early period of the disease, an aching of the limbs on standing, or after exercise, may be the only symptom, a local pain occasionally indicating the seat. In a more advanced period, œdema around the ankle may be observed.

When the femoral vein, where the grand venous junction takes place at the saphenous opening becomes dilated, the swelling may, on a careless examination, be mistaken for a *femoral hernia*, for both will disappear on the patient assuming the recumbent posture, and reappear on his coughing. There is, however, this point of distinction, that while by local pressure on the crural ring a femoral hernia can be kept in its position, a femoral varix can be made to enlarge.

As a secondary result of varicose disease, the blood in the vein may coagulate, giving rise to *thrombosis*, and this coagulum may break up, causing a local abscess, or, it may wither and organize, causing occlusion of the vein, and, consequently, a partial cure. There is reason also to believe, that this may dry up and become so altered as to form what are known as *phlebolithes*, as these have a laminated character, and, in Dr. Franklin's analysis, are said to be composed of protein matter and phosphate of lime, with a little sulphate of potash and lime.

With varicose disease of the veins there is very frequently associated an eczematous condition of the leg, the eczema being apparently due to the feeble venous circulation of the part. If this eczema be neglected, a superficial ulceration of the skin may ensue, and if no attention be paid to this condition, the ulcer becomes chronic. But beyond this, no special form of ulcer can be said to exist as a result of varicose veins, in fact, there are no "varicose ulcers." In practice every variety of ulcer is found associated with varicose disease, and the existence of the latter doubtless renders the repair of the former somewhat more difficult. Thus it appears that chronic indolent sores associated with varicose diseases have been termed "varicose ulcers."

TREATMENT.—Varicose disease of the veins in its early stage is very amenable to treatment, but, later on, none are more obstinate; the patient being only relieved, and rarely cured. Happily, however, under common care it never threatens life.

When the affection is first discovered, the local treatment must be directed to assist the venous circulation by the raised position of the limb, the patient being recumbent; friction, too, should be steadily applied upwards; all sitting, standing, or walking be strictly prohibited; and, when possible, this treatment should be persevered in for three or four weeks. When exercise is allowed, steady pressure by a well-applied bandage from below upwards should be maintained, or an elastic stocking worn, and, in the course of time, the extent of which greatly varies, a cure may be effected and maintained.

During this time, the general treatment must not be neglected. Where the powers are feeble, tonics must be given, and of these, iron is the best; twenty drops of the tincture of the perchloride, with ten of the tincture of nux vomica being an excellent compound.

A generous diet must be given when indicated, and the reverse where the portal system has been overgorged by excess. Mild aperients are always of value under these circumstances, salines being preferable to the purgative extracts. The natural waters are of great value.

When rest cannot be given, well applied pressure must be relied upon, the best forms being a pad of cotton wool over the part with a bandage of Dommett's or elastic tissue, applied from the toes upwards, or good strapping evenly applied. The patient must be impressed, however, with the necessity of assuming the horizontal position as much as he can; aiding the circulation by friction as already indicated, and by general treatment. The bandage should always be put on before the legs are moved off the bed, and removed only after the recumbent position is again resumed.

In bad cases of local varix, the pressure may be more local and permanent; a pad of cotton wool well fixed on by strapping being very valuable. When the veins are inflamed, they must be treated on principles already laid down in the chapter on phlebitis.

If a vein burst, bleeding can be controlled by the application of a finger to the spot, and any further flow is prevented by the elevation of the limb. A pad carefully adjusted to the bleeding point and fixed by strapping applied like a bandage or by a roller, makes the patient safe.

OPERATIONS FOR VARICOSE DISEASE OF THE VEINS.

It has been observed, that nature not unfrequently obliterates a varicose vein by means of a coagulum which subsequently contracts and even organizes, the clot and vein together forming an impervious cord. Acting on this knowledge, surgeons now endeavor to make use of nature's processes, and, by artificial means, to induce coagulation of the blood in some portion of the varicose vessel with the hope that it may contract; or, so to destroy some part of the vein itself as to compel the circulation to find another course. This is the so-called "radical cure"—but it is to be thought of only, as Mr. Gay so truly says, when the vein is hopelessly deteriorated, or so inflamed and painful as to threaten to burst; or, in cases in which all palliative and other treatment is inapplicable or has failed.

Caustics were employed by Mayo for this purpose, and also by Brodie, Key, and others. They should be thus applied: A small piece of Vienna paste (composed of four parts of potassa fusa and four of quicklime, made into a paste with spirits of wine prior to its application), or chloride of zinc paste of the size of a small pea, should be applied upon the vein—the surrounding skin being previously protected by a ring of plaster carefully adjusted; the paste should be fixed on and left, the object being to cause a slough through the tissues into the vein. This slough should not be large, but three, four, or more applications may be simultaneously made about an inch apart, in order to guarantee success. The caustic may be left for twelve or twenty-four hours and then removed, water dressings being afterwards applied to the part. During all this treatment, the patient must be kept in bed with the limb raised.

Subcutaneous division of the vein was practised by Brodie, but after some experience, he came to the conclusion, that "it really appears it is not worth patients' while to submit to it."

Excision of a portion of the diseased vein has likewise been employed with some success. My colleague, Mr. Davies Colley, in 1874 reintroduced the practice ('Guy's Hosp. Rep.,' vol. xx, series iii), which has been followed by Mr. Howse and others. The operation consists in the exposure of the varix by a free incision and its removal after the application of a carbolized catgut ligature to the trunk of the diseased vein above and below. Mr. Marshall, also, in 1875, adopted a like practice ('Lancet,' June 23d, 1875), taking away some inches of diseased vein with forceps and scissors, after having isolated the portion to be removed by means of pins passed under the vein above and below. I think the operation is beneficial when the varix is local and requires surgical interference.

Another operation much favored and practised is that of *acupressure*. It is performed by passing a pin beneath the vein, but not through it, as in Davat's plan, and obstructing the circulation through the vein by means of a twisted suture either of silk, india-rubber, or wire applied round the pin, or, by a piece of thin india-rubber stretched across it on the pin, as suggested by Mr. Lee. Two or even six of these acupressure needles may be inserted about an inch or an inch-and-a-half apart, according to the extent of the disease. Mr. Lee employs also the subcutaneous division of the vein between the pins at the same time, and my own experience confirms the wisdom of this practice. Mr. Wood employs an elastic steel spring to keep up tension on the ligature till it cuts its way through the vein.

On several occasions, having obstructed the circulation through the vein as already described, I have injected the vein between the pins with perchloride of iron, one drop being generally sufficient to cause coagulation of the blood; in others, I have used a concentrated solution of tannin; and in all, a good result ensued. The syringe should be that used for hypodermic injections.

The time for withdrawal of the pins varies according to the effect intended to be produced. When inserted to induce coagulation of the blood only and not inflammation, they may be withdrawn on the third or fourth day, and, in the practice suggested of acupressure and injection this plan should be followed. Sir W. Fergusson states, "they should be left until they have excited considerable swelling and slight ulceration, and in some instances, where the former is not very conspicuous, they may be permitted to separate by ulceration through both vein and skin. I recommend that the process of inflammation should be more implicitly relied upon than that of coagulation." He adds, moreover, that he has not met with any seriously unpleasant effects out of the numerous instances in which it has been employed.

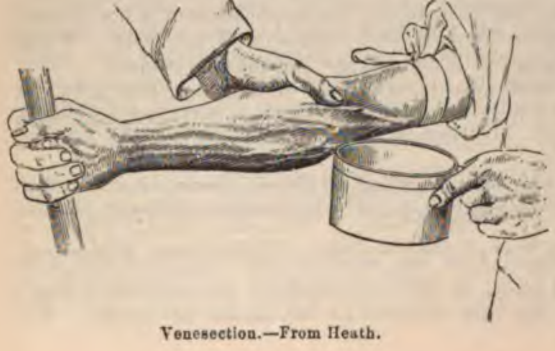
It must be repeated, however, that these operations should be practised only in extreme cases and not where palliative treatment is applicable. When a vein threatens to burst, or has burst and endangers life, surgical treatment is justifiable.

Mr. Gay called attention (Lond. Med. Soc., Oct., 1871) to a class of cases in which the superficial or complementary veins, as he calls them, are obliterated; and, as a result, the return of the venous blood is carried on entirely by the deep veins. These consequently become diseased, the circulation through them grows feeble, and degeneration of the tissues ensues, associated with deap-seated solid œdema of the limb, not subcutaneous œdema, which belongs to obstruction only in the subcutaneous veins. For this disorder exercise, warm applications, tonics, &c., are required; but bandages and rest do harm.

VENESECTION.

At the present time this operation is very rare indeed, and at Guy's Hospital it is as rare as, if not more so than, amputation. Forty years ago it was one of the most common, and there seems some reason to believe that it will soon be practised again with greater frequency, especially when we find Sir James Paget asserting "that we undoubtedly overvalue the blood, and estimate too cautiously the loss of it;" that "the loss of blood up to fainting and in some cases I remember, with those epileptiform convulsions that come with the loss of blood, is absolutely harmless," that is, when performed upon a large series of healthy persons, as was the custom in his student's days. ('Lancet,' Aug. 15th, 1874.)

FIG. 163.



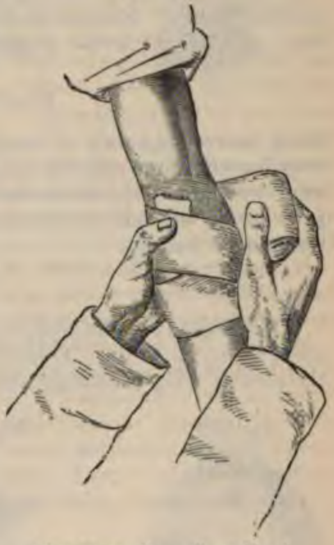
Venesection.—From Heath.

It is not a difficult operation, but requires nicety and care. It is usually performed at the bend of the elbow. The first thing the surgeon has to do is, to render the veins prominent by arresting the circulation through them by means of a piece of broad tape or narrow bandage carried twice round the arm a few inches above the elbow, and tied in a bow, but not tight enough to stop pulsation in the arteries (Fig. 163). He then selects the vein, the largest being the best. Where the outer vein or median cephalic is of good size, it should be chosen, as the inner or median basilic lies immediately over the brachial artery; either, however, may be selected, care being observed not to go *through* the vein. He should also assure himself that no malposition of the artery exists, as many cases are on record where a superficial artery has been opened for a vein.

The vessel then having been selected, the surgeon should stand in front of the extended arm and hold it with his left hand, the thumb being fixed on the vein below the spot which is to be opened. With his right hand, an oblique incision, not a puncture, should be made through the skin into the vein, describing with the lancet a semicircular movement. The bleeding basin having been brought close to the arm, the surgeon's left thumb may be removed, and the stream of blood allowed to flow. If this be feeble, the patient may be asked to grasp a stick and put the muscles of the forearm well into action.

The required amount of blood having been withdrawn, the tape can be removed, the left thumb of the operator being applied to the wound, and the parts cleansed. A pad of lint is then to be placed over the incision, its edges kept well in contact, the thumb being slipped downwards to allow of the adjustment of the pad, which is to be fixed by a figure-of-8 bandange (Fig. 164). The arm should then be slightly bent, care being taken that the pad does not slip during this process.

Fig. 164.



After venesection.—From Heath.

On the second or third day, the pad may be removed, the wound having probably healed by that time.

Opening the external jugular vein is sometimes called for, particularly when venesection is required in a child, and that part of the vein where it passes over the sterno-mastoid muscle should be selected. The vein can be steadied and rendered prominent by the left thumb of the surgeon applied at the root of the neck above the clavicle, or this may be done by means of a pad. It then is to be opened with the lancet by an incision made in the course of the sterno-mastoid muscle, and consequently across the platysma. Blood will then flow freely; and when enough has been taken the wound should be closed by means of a pad carefully adjusted. The thumb, which hitherto has been acting as a compress, may then be removed. The pad should be fixed by good strapping.

In both these operations of venesection, if the wound in the skin be made smaller than that in the vein, or the position of the arm be changed, a blood tumor or thrombus may form from the escape of blood beneath the integument; and if this interferes with the flow of blood, instead of reintroducing the lancet, the best practice is to untie the arm and apply a pad to the wound, opening a vein in the other arm.

In fat subjects there is occasionally some difficulty in finding a vein. Friction of the surface of the forearm will at times help the surgeon, or, the application of a hot flannel round the arm, which should be made to hang down by the side of the body. When these means fail and venesection is imperative, a vein of the foot may be opened.

In opening the jugular vein, great care must be taken not to admit air into it by the removal of the thumb during the operation and until the pad has been adjusted, otherwise life may be endangered.

Gross, Dr. S. W., 'American Journ. of Med. Science,' 1867 and 1871.—*Callender*, 'Holmes's System of Surgery,' 2d ed., 1870.—*Travers*, 'Surgical Essays,' 1818.—*Langenbeck*, of Berlin, 'Archiv fur Klinische Chir.,' 1860.—*Arnott*, 'Med.-Chir. Trans.,' vol. xv, 1829.—*Lee, Henry*, 'Disease of Veins,' 1866.—*Greene, James S.*, Dorchester, Mass., 'American Journ. of Med. Science,' 1864.—*Gay*, 'Varicose Diseases of Leg,' 1868.

THE SURGERY OF THE DIGESTIVE ORGANS.

CHAPTER XII.

AFFECTIONS OF THE LIPS, MOUTH, TONGUE, PALATE, AND TONSIL.

Wounds of the Lip.

Under all circumstances these wounds should be well cleansed and all foreign bodies removed. They should always be brought together by sutures, which ought, if any gaping exists, to be deeply inserted, as less deformity is likely to follow this practice than when the parts are left to granulate. Superficial wounds in the inside from the teeth may be left to granulate. When much bleeding exists the surgeon should examine the part with care, as Erichsen adduces a case in which so much blood was lost from the coronary artery, swallowed, and brought up again by vomiting, as to lead to the suspicion of some internal injury. Sutures in the lip are almost always removable on the second or third day. Plaster, as a rule, is not required.

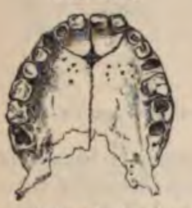
Congenital Fissures of the Lips

occur more frequently as harelip than in any other form. Sir W. Fergusson has, however, quoted three cases in his 'Practical Surgery,' in which the fissure extended from the angle of the mouth, in one case to the malar bone, in the second towards the angle of the jaw, and in the third to the base of the lower jaw. The treatment of these should be the same as for harelip.

Harelip.

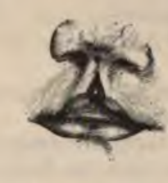
This congenital deformity is due to a want of union between the natural centres of development of the upper lip. Thus the upper lip is made up of a central and two lateral portions, the central being connected with the intermaxillary bones, and the lateral with the superior maxillary (Fig. 165). A want of union between the central and lateral piece on one side gives rise to simple harelip; a want of union between the central and lateral pieces to double harelip.

Fig. 165.



Showing the development of the intermaxillary and maxillary bones.—From Fergusson.

Fig. 166.



Central fissure of lip, with deficiency of intermaxillary bones. Mr. Howse's case.

When the fissure is central—a very rare condition—the intermaxillary bones are either absent or divided. A specimen of the former exists in the museum of the Royal College of Surgeons, London, and a drawing of a like case taken from a patient of my colleague, Mr. Howse, is seen in Fig. 166. These fissures may be partial or complete, and may involve the skin alone as also the bone, and the latter in variable degrees.

Fig. 167.

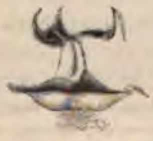


Fig. 168.

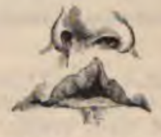
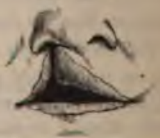


Fig. 169.



Drawings illustrating the different degrees of single harelip.

I have seen in the lip of an adult (Fig. 167) a congenital cicatrix on the left side of the upper lip with a slight elevation of its mucous margin, said to be the very earliest indication of a harelip, and the child of this woman had a complete fissure. In more complicated cases the cleft will extend through the alveolar process in a line corresponding with the labial fissure; in others it will involve the hard palate; while in a still worse class both hard and soft palate will be fissured.

In a small percentage of the cases—about a tenth—the harelip is double. In these, it is not uncommon to find a double fissure extending through the palate; the two superior maxillæ with the skin having failed to unite with the intermaxillary bones. Under these circumstances, the intermaxillary bones will often project, covered with a small flap of skin, and at times even stand out from the tip of the nose. In a rare case (illustrated in Fig. 171), the fissure involved the lip and intermaxillary bones alone, the maxillæ being complete.

These points are well illustrated in the annexed drawings which have been taken from patients to show the different degrees of the deformity.

This affection is more frequent on the left than on the right side of the mouth, and is more common in males than females, while in the more complicated this disproportion becomes more striking. Thus, in an analysis of cases to be found in my 'Lettsomian Lectures on the Surgical Diseases of Children,' 1863, four-fifths of the bad cases were in boys, those of double harelip almost always being found in the male sex.

Fig. 170.

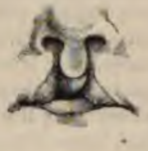
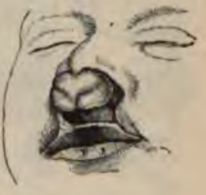


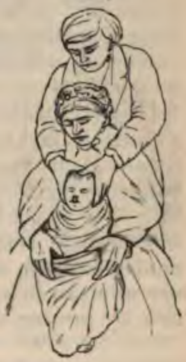
Fig. 171.



Double harelip.

Treatment. — When ought a child with harelip to be operated upon? Sir W. Fergusson says, "I am of opinion that the earlier the operation is performed the better—assuredly before teething;" and the majority of surgeons would support this opinion. Judging from my own experience I am not disposed to coincide altogether with this opinion, for in my analysis of cases at Guy's Hospital, a larger number of failures followed the operation when performed during the first few weeks of life than after the third month. In healthy infants, it is probable that success may attend the operation whenever undertaken; but in the more feeble it is equally probable that success will be more certain at a later than at a very early period. Under these circumstances I always advise the operation to be postponed until after the third month; that is, when no necessity exists to hurry on the operation such as inability to take food, &c. On account of this last-named condition, I have operated with complete success on the fifth day.

Fig. 172.



The position of the patient is important. If an infant, the whole body and arms should be bound round with a good towel, and the head fixed by the hands of an assistant placed on either side. The child should be firmly held in a nurse's lap, in the sitting posture (Fig. 172).

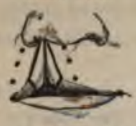
If an older child, the semi-recumbent position should be chosen with the head raised on a pillow and fixed as directed above. Under these circumstances chloroform should always be administered. When given to an infant, the head may be laid on the surgeon's knees, the body on the nurse's.

The operator may sit or stand behind the patient when the recumbent position is selected, or, at one side, if the patient be sitting.

The operation. — Anæsthetics may be given without fear in such cases, although in uncomplicated examples the operation is so expeditiously performed as not to render it essential. I operate as frequently without as with it.

The surgeon has two main objects in view in the operation, viz., to pare the edges of the fissure, and to adapt them, so as to render the deformity as slight as possible. But before this an important preliminary step demands attention, on which the success of the case materially rests, and that is, the free separation of both sides of the lip from the alveoli, and, when the nostril is widely expanded, the free separation of the ala nasi from the bone; the object of this step being to allow the soft parts to move freely over the bones and to be brought the more readily into apposition. Some save the true frænum and divide all other adhesions; but from my experience, I see no necessity for this practice.

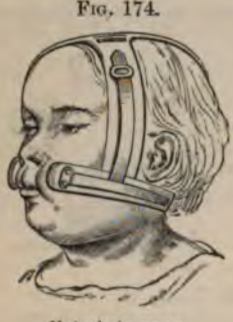
FIG. 173.



Operation for single harelip.

To pare the edges of the cleft, the knife should be employed; such an instrument making a cleaner section than scissors, and this cleanness of the incision is a point of importance. With respect to the form of incision, numbers have been devised, but most surgeons fall back upon the old-fashioned straight one, commencing at the apex of the cleft and ending at its free border, care being taken to cut off a good piece. The plan I now always follow when the knife reaches the red border of the lip, is to turn its edge obliquely towards the cleft, thereby saving a portion of the mucous covering of the lip, and lessening materially the notch in it (Fig. 173). The incision then having been made, and any bleeding vessel twisted, the surgeon should proceed to adjust the parts, and he had better commence at the free margin. When pins are used they should be fine, with flat heads, and one should be introduced about a third of an inch from the margin of the wound and brought out just under the mucous lining of the lip, reintroduced on the opposite side and passed through the lip. The edges can then be brought together by means of a twisted suture, care being taken to adapt accurately the parts at the red margin of the lip. If this can be attained, the second and third pins should be inserted above, one close to the nostril, the second between the two, and both fastened separately. If the interrupted silk, gut, or horsehair suture be employed instead of pins, a practice I greatly prefer, having given up pins in simple cases, it is wise to introduce a needle as the first pin to adjust the parts, and then insert the second and third stitches, putting in afterwards the marginal suture by simply drawing the needle that had been introduced as a pin through the flaps. In some cases, it is serviceable to insert a fourth suture into the red border of the lip itself.

FIG. 174.



Hainsby's truss.

After the operation Hainsby's truss should be employed when possible (Fig. 174). It keeps the parts well together and prevents any traction upon the wound. It is an invaluable instrument. When it cannot be obtained the cheeks should be well drawn forward and held by some good plaster applied either from ear to ear or from the temple on one side beneath the chin to the temple on the other. When pins are employed this practice can hardly be followed. The sutures or pins may generally be removed about the second or third day at the latest, and, after their removal, the cheeks must be held forward by strapping.

Mr. Maurice Collis, in 1866 ('Dub. Quart.'), in an able paper on harelip, among other points laid great stress upon the propriety of utilizing the parings. He never threw away a particle of them but used them all. I have followed his suggestions in many cases with admirable success, and am disposed to think that where the lips are thin his method is of service. His operation is as follows: He first made an incision from A to B (Fig. 175), through the thickness of the lip down to the mucous membrane, but not through it, and turned the flap back. On the other side, he transfixed the lip at C, and separated the flap as far as D, dividing the flap in the centre at E. He then brought the two sides together, the loose lateral flaps covering in the semi-attached one in the central bit. The upper flap C E was fixed by a suture to A, and the lower flap E D to B. Two intermediate sutures being applied (Fig. 176), I thus obtain, says Collis, "a lip nearly double in depth what I could possibly have got by the ordinary incisions." Malgaigne's operation is, in a measure, somewhat similar to the above, utilizing as it does the flaps of skin by turning them down and stitching them together (Fig. 177). In some cases, one of the pared edges may be left attached and united with the opposite side that has been sloped to receive it. This suggestion I had from Mr. Dix, of Hull, in 1859. ('Med. Times and Gaz.,' July 2d.)

FIG. 175.

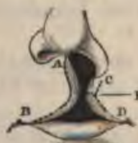
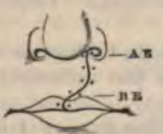
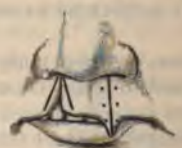


FIG. 176.



Collis's operation for harelip.

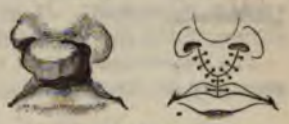
FIG. 177.



Malgaigne's operation. From Holmes.

Double harelip.—When this is uncomplicated with bone displacement, it can be dealt with as simple harelip. In a general way it is well to operate on both sides at once, more particularly, if the lower flaps of the lateral portions are utilized by being turned down and united beneath the central piece (Fig. 179). If there be, however, much separation, and, consequently, traction upon the lateral portions, the operations upon the two sides should be performed separately.

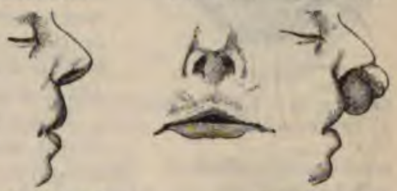
FIG. 178. FIG. 179.



Operation for double harelip.

When the intermaxillary bones project to any extent and are separated from the maxillary, there will be some difficulty in the treatment. I believe the better plan is to remove them with the knife or scissors, for when broken and bent back, the central incisor teeth too often grow in some abnormal position and are in the way. When removed, the maxillary bones subsequently approximate, and the lateral incisor teeth frequently assume the position of the central. Sir W. Fergusson latterly removed these bones, or the milk tooth with its bony bed, subcutaneously, and, I think, with advantage. When they are pushed so forward as to form a kind of appendage to the tip of the nose, as seen in Fig. 180, they ought to be removed. The portion of skin over the bones, however, must always be utilized, either to form a columna nasi where none existed, as in Figs. 181 and 182, or, to be brought down, and inserted between the two lateral portions of the lip.

FIG. 182. FIG. 181. FIG. 180.



After operation. Before operation.

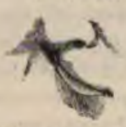
(From patients.)

When primary union fails, the surgeon can often succeed by scraping the surface of the wound and re-applying the sutures; and he may do this, although the parts have sloughed at first as soon as healthy granulations appear.

CHEILOPLASTIC OPERATIONS.

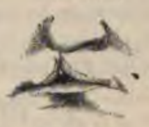
These are demanded for deformity of the mouth from destructive ulceration or sloughing, as from cancrum oris, and are somewhat similar to those for harelip. When undertaken for contraction of the mouth, the surgeon should always try and turn up from within the mouth, some portion of the mucous membrane to cover over the new angle, and thus prevent its subsequent contraction. I have done this in several cases with gratifying success; one of which is shown in Fig. 183. The deformity was the result of sloughing after fever. At times new tissue must be brought up from the chin or down from the cheek. Indeed, these cases tax the ingenuity of the surgeon to the utmost, as no general rules can be laid down regarding them; each requiring to be dealt with on its own merits. But this much may be said, that no part of the body heals so rapidly or so well as the face, and in none are plastic operations more satisfactory.

FIG. 183.



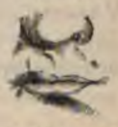
Deformity result of slouging.

FIG. 184.



After first operation.

FIG. 185.



After second.

CANCER OF THE LIPS.

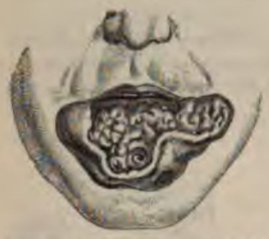
This term is generally applied to epithelioma or cancroid disease, true cancer or carcinoma being very rare. It is a disease of middle life, four out of five cases attacking patients between forty and sixty years of age. The youngest subject I have seen affected by it was a sweep æt. 27, and the oldest also a sweep æt. 86. It affects the lower lip more frequently than the upper in the proportion of 25 to 1, and men more than women. In my own table of fifty-four consecutive cases, three instances of the latter exist, to fifty-one of the former.

Smoking, or rather the irritation of a pipe, has generally been ascribed as a common cause, and it is probable that such an irritation is sufficient to set up the disease when a predisposition to its development already exists. It is interesting to note, however, that in fifty-four consecutive cases in which I made the inquiry, nine had never smoked, and this proportion is probably, in this country, about that of the non-smokers amongst the male population.

The disease generally commences as a dry scab on the red margin of the lip; and it may be that this scab forms over a crack or excoriation, but as often as not it appears alone; occasionally too it commences as a wart. In its early stage the progress of the disease is generally very slow, and only when some ulcerative action appears does it develop more rapidly. It is under these circumstances that the patient first applies for advice, in the dry stage the disease is passed by unheeded.

The appearance of an epithelial cancer is tolerably characteristic (Fig. 186); it has generally an irregular warty aspect, but, when ulcerating, has thickened everted edges. It has always a well-defined indurated base. When ulcerating, it discharges a sanious pus containing epithelium scales in abundance, and when dry, it is covered with a scab of the same material. Microscopically it contains epithelial elements arranged in capsules. (*Vide* Fig. 32.)

Fig. 186.



Cancer of lip in John C—, æt. 45. From drawing.

In its early stage it seems to be a local disease and rarely affecting more than one part at the same time. I have, however, seen several cases in which two separate centres existed, and one in which there were three. In the latter, two growths on the lower lips were excised, and nine years subsequently a similar disease attacked the tongue, which I removed in June, 1870, with the galvanic cautery écraseur.

When the ulceration stage has set in, if the disease be left to run its course, the glands beneath the jaw will probably soon become affected. Indeed, under these circumstances, the progress of the affection will be steady, if not rapid, and goes on to destroy all the tissues with which it comes in contact—integument, gums, bone, teeth, and glands. It destroys life by exhaustion, and may do so by secondary deposits in the lungs or viscera, but far less frequently than in carcinoma.

TREATMENT.—There is only one treatment that can be recommended, and that is, the speedy removal of the disease. When once the nature of the case is clear the sooner the growth is taken away the better; and, in doing this, the surgeon must also deal freely with the surrounding parts. He had better err by removing too much than too little of the surrounding tissues. To tease the parts with mild caustics is bad practice, as it merely irritates and rarely destroys the whole growth. Caustics cannot, as a rule, be recommended. Excision is probably the best method. When the disease is superficial, it may be sliced off, leaving the parts to granulate; when it involves more of the lip, a V-shaped piece may be taken out, the two edges being brought together as in harelip. When much of the lip is affected, the whole must be removed, and a new lip formed by bringing up the soft parts from the chin as indicated in Figs. 187, 188.

Fig. 187.

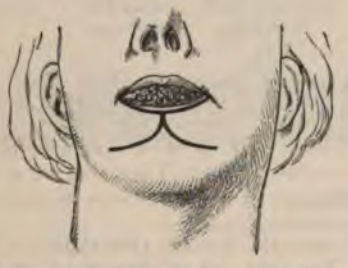


Diagram showing the lines of incision for new lip after removal of cancer.

Fig. 188.

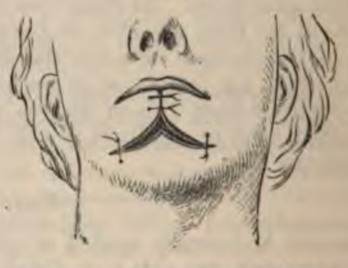


Diagram showing position of flaps when brought up.

I have, however, with the galvanic cautery removed many superficial cancerous tumors of the lip with success, having isolated the growth with pins, and then removed it with the wire passed beneath them.

After the removal of the disease, a cure may follow; but in the majority of cases, a return takes places, and generally in the same spot. Similar treatment must again be resorted to, even to a second and third operation, as there seems reason to believe, that, after each operation, a longer interval of immunity may be promised. Thus, a man who had a cancer of the lip removed a year after its appearance was well for two years, when a second operation was required. He remained well for three years, when a third was performed, and this time four years elapsed before a return took place. It was then excised for a fourth time.

In another case, a man, æt. 65, had a cancer of his lip removed fifteen years before he came under my care. He remained well for eight, when, the disease returning a second operation was demanded; and seven years after this he was well. Epithelioma of the lip is of slow growth. I have removed one from a man, æt. 74, of twenty years', and another from a man, æt. 50, of eight years' growth.

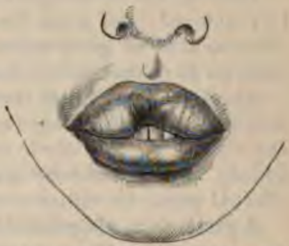
Horny growths may spring from the lip as from other parts of the cutaneous surface. (Prep. 1678^5, Guy's Hosp. Mus.)

Chancres, syphilitic or otherwise, are at times met with on the lips, and so the surgeon should be on his guard not to mistake them for cancer. They have neither the clinical history nor aspect of such an affection, but make much more rapid progress. They are usually likewise attended with considerable inflammatory swelling as well as with secondary glandular enlargement. They are, moreover, usually met with in younger subjects than is cancer. When syphilitic, the constitutional symptoms will mark their true nature.

Hypertrophy of the Mucous Glands of the Lip.

The mucous covering of the lip is often found to be thickened, two elevated or pendulous portions of tissue appearing, one on either side of the middle line. This condition authors have described as *Hypertrophy*, though the name does not appear to be correct, for, on removing the so-called hypertrophied mucous membrane, a number of small granular bodies the size of hemp-seeds, and made up of gland-cells, are always found underlying a healthy mucous membrane. The disease appears, therefore, to be due to an increase in the size of the natural glands, and not of the mucous membrane of the part (Fig. 189). It should be treated only by the careful excision of the diseased submucous tissue—the incision being made in the line of the lip, and the edges brought together by fine sutures. I have seen as many of such cases in the upper as in the lower lip; and rarely does it involve both lips. I have never known it to recur.

Fig. 189.



Hypertrophy of mucous glands of lip.

A genuine hypertrophy of the lip itself is a common affection. It often begins as a chronic inflammation of the part, or rather œdema, the inflammatory deposit becoming organized. There can be little doubt that many of the so-called thick strumous lips have this origin. Attention to the general health and its improvement are the means by which any cure may be expected.

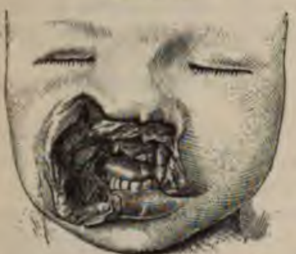
Cystic Tumors of the Lip.

Mucous cysts are often seen and generally in the lower lip. They appear as tense, globular, and at times semi-translucent tumors beneath the mucous membrane, and are readily cured by excision or by cutting off their upper wall by means of scissors and sharp-pointed forceps. An incision into them rarely does good. They contain a glairy mucoid fluid. On several occasions, I have turned out of the lip, from beneath the mucous membrane, solid encysted tumors, with a glandular structure.

Nævi of the lip are often seen, and when they involve the whole thickness of the part their excision by a V incision is the best treatment. I have done this on many occasions with a beneficial result. When they are only superficial or beneath the mucous lining, they may be treated locally, as already mentioned in the chapter on nævus.

Phlegmonous or carbuncular inflammation of the lip is an alarming affection; it is never found except in the feeble and cachectic. It attacks the upper as well as the lower lip, and shows itself as a general infiltration of the part, which becomes enormously swollen, tense, and painful. When seen in an early stage a free incision into it or its mucous surface gives relief and expedites the sloughing of the cellular tissue that is sure to follow. Fomentations and warm-water dressings are the most beneficial, with good living and tonics, such as quinine and iron in full doses. At times this affection ends in sloughing, and then puts on the appearance of what is called cancrum oris. It is very prone to be followed by septicæmia.

Fig. 190.



Cancrum oris.
Model 26^{3}, Guy's Hosp. Museum.

Cancrum oris, or gangrenous stomatitis, is generally met with in the ill-fed and feeble child after one of the exanthemata. It is seen also where mercury has been given to salivation. It commences often as a phlegmonous inflammation of the cellular tissue of the cheek or lip, going on rapidly to sloughing and phagedænic ulceration, or to sudden death of a part of the cheek, the tissue becoming white and bloodless, and then sloughing. At times, this sloughing process will involve a large portion of the cheek, and even of the gum or bone. It is a most fatal and dangerous disease. Before the sloughing has taken place, the part involved will be much thickened and indurated. It will feel of a brawny hardness, and appear of a dusky color in the centre, with a red border. When the skin covering in the dead cellular tissue has sloughed away, a deep, excavated, irregular surface will be seen discharging an offensive sanious fluid, and, if the disease spreads, it does so by sloughing and ulceration (Fig. 190). It generally kills by exhaustion, sometimes by bleeding from the sloughing of an artery.

Treatment.—The general treatment is, tonics and good feeding, milk, eggs, and wine, beef tea, and any other nutritious food being of primary importance. When food cannot be taken by the mouth it must be given by the bowel as enemata. Tonics also must be administered, as the liquor cinchonæ, quinine, or iron, in such doses as the child can bear.

Locally, till the slough has separated, little more than fomentations and cleanliness can be employed; but when the sloughing and ulceration spreads the application of strong nitric acid is of great value. It must, however, be liberally brushed over and into the parts so as to destroy all their surface and induce a fresh action.

Absolute cleanliness should be observed, the wound being washed and irrigated by means of a steady stream of water to which carbolic acid 1 part to 20, Condy's fluid, chloride of zinc, or nitric acid in the proportion of ♏v to the ounce of water may be added. When recovery takes place, it is frequently with the loss of large portions of the affected parts, for which some plastic operation will subsequently be required.

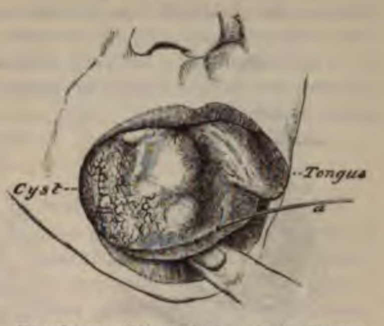
Aphthous stomatitis is another affection often mistaken for cancrum oris, but is not, however, half so dangerous. It occurs likewise in the unhealthy and ill-fed child, but as often as not is independent of the exanthemata. It begins as an aphthous ulceration of the tongue, gums, lips, or cheeks, by which these parts become covered with a white or ash-colored secretion. With these local symptoms there will be a foul tongue and fetid breath, as well as some evident symptoms of derangement of the bowels and digestive organs. In very feeble children this superficial ulceration may pass on to sloughing of the parts, or *ulcerative stomatitis*, thus simulating *cancrum oris*, but with this difference—in *cancrum oris*, the disease begins in the cellular tissue, the skin sloughing subsequently; in *ulcerative stomatitis* or *noma*, it begins as a skin or mucous membrane ulceration, sloughing following upon it.

Treatment.—Of all drugs, the chlorate of potash has the best action, and should be administered in five- or even ten-grain doses mixed with bark, or with milk, a lotion of the same drug, ʒj to a pint of water, being used as an application. Milk diet is the best where it can be taken, beef tea and eggs being given otherwise, or, in addition. Wine must be administered with great caution, and only when the powers of the child are very feeble, as in the phagedænic form. A rhubarb purge is usually required at the beginning of the affection to clear the way, as foul excreta are too often present, and, in the later stage, the more powerful tonics, such as iron or quinine, are often demanded. It is a disease generally due to intestinal irritation from bad feeding, and requires, therefore, for its treatment, careful attention to this matter.

Ranula or Sublingual Cysts.

These are now known *not to be* due to any obstruction of the salivary ducts, submaxillary or sublingual, but to obstruction of one of the mucous glands situated beneath the tongue, such as the glands and ducts of Rivini. They are probably analogous to the mucous cysts of the lip already alluded to, and of the mucous passages generally. They

Fig. 191.



Ranula or sublingual cyst, with salivary duct lying upon it. Guy's Hosp. Mus., No. 229^{38}.—Hilton's case.

ntain a clear, glairy, mucoid fluid, but never saliva. have the notes of several that were *congenital.* hey sometimes attain a large size, and, when placed neath the tongue (their usual position), the salivary uct can readily be traced lying over them (Fig. 91). Sometimes they are multiple, and, on several casions, on opening one cyst, I have seen a second ithin. When neglected and allowed to increase, hey may so press the tongue upwards as to prevent he patient speaking, or, they may form a large swelling beneath the jaw.

Within the mouth they appear as semi-transparent ysts beneath the tongue, and they are, as a rule, ainless and merely give trouble mechanically. When pened a glairy mucoid fluid escapes. This operation, however, rarely is serviceable as the fluid reollects. The best treatment is, to raise the upper urface of the cyst by means of a pair of pointed forceps or a tenaculum, and with scissors ut off its upper surface. M. Panas, of Paris, has lately injected these cysts with three o ten drops of a solution of chloride of zinc (45 grains to an ounce of distilled water) with uccess. In large tumors the cavity may be plugged with lint soaked in iodine after it has been freely incised. The application of a seton is at times beneficial though an uncertain remedy; simple plugging of the cyst was a mode of treatment that I formerly employed till I discovered that the plans above suggested were preferable. It is next to impossible to excise them, as they have no definite walls.

Encysted tumors are, however, met with beneath the tongue. I have had two under care, and both I mistook for ranula. The error was discovered only on opening them; and in both, on making my incision, I had to cut through the mucous lining of the mouth over the cyst, and the cyst-wall itself. From both a cheesy sebaceous secretion escaped.

These tumors have nothing to do with ranula, have distinct capsules beneath the mucous membrane, appear to be sebaceous, and are probably congenital. In the case I have mentioned the patients were under twenty years of age. In both I pulled out as much of the cyst-wall as I could, dissecting it from its bed, and in one with complete success. In the second a return followed, which called for another operation, which was crowned by a good result. I have never known any of these sublingual cysts require removal from below the jaw; though the sebaceous form might do so. In one of my cases I contemplated this plan, and Sir W. Fergusson gives a case where it was adopted. It is probable, that plugging of the cyst, to set up suppuration, would be a simpler and equally efficacious practice.

SALIVARY CALCULUS.

The salivary ducts beneath the tongue may be obstructed in exceptional cases, from the introduction of foreign bodies, but more commonly from *calculus.* Steno's duct or that of the parotid may be thus affected, but the Whartonian or the sublingual salivary duct is that more commonly involved. When the obstruction is complete patients complain, during deglutition, of pain in the corresponding salivary gland, with some swelling, such symptoms being clearly due to retained salivary secretion; and these soon subside on the completion of mastication. In exceptional examples suppuration may attack the gland.

The calculus depicted in Fig. 192 was taken from the sublingual duct of a man by my friend Mr. C. Sells, of Guildford, and weighed 48 grains.

This affection can usually be easily recognized on the application of the finger beneath the tongue, the calculus, as a rule, holding a superficial position. On feeling the stone, the surgeon may often with his nail tear it out of its bed. I have removed several by this plan when not larger than hemp-seeds. When larger, the best plan is incision, the surgeon being careful to cut through the duct where it seems to be thinnest, and scoop the calculus out of its bed by means of a director or bent probe. These calculi may attain considerable dimensions, even one inch long. On one occasion, I broke a calculus to pieces, in attempting to remove it from the centre of

Fig. 192.

Nat. size

Salivary calculus, weighing 48 grains.

a suppurating sublingual gland of a man, æt. 42, who had had evidence of its presence for years. He came to me with the parts hard as well as ulcerating, having been told he had a cancer, and a rapid recovery followed its removal. Occasionally after the removal of a calculus from a salivary duct a stricture results, when the gland under stimulus may inflame and be the source of trouble. A free division of the duct is then the right treatment to adopt.

SALIVARY FISTULA.

When Steno's duct, the duct of the parotid gland, has been obstructed near its orifice in the mouth, or has been opened by a wound or ulceration, a salivary fistula may take place, that is, the saliva, instead of being poured into the mouth, will escape upon the cheek. When this affection originates in some obstruction to the duct itself, it will commence as a soft fluctuating swelling in the cheek caused by retained salivary secretion; and, after a time, usually when the duct has acquired about the size of half a walnut, the swelling will ulcerate through the skin, and clear saliva or saliva mixed with pus will escape. If this swelling be opened the same result will ensue, and after this, the cavity may contract, but the fistula will remain.

The only successful treatment of this affection is, to establish a free opening into the mouth from the oral end of the duct, which may be effected by passing a fine probe into the fistula through the duct into the mouth. When this can be accomplished through the natural opening all the better, but it is not a matter of much importance, as artificial opening near the oral orifice of the duct will answer every purpose. The probe should be armed with a piece of thick silk, or three or four threads of fine silk, and drawn through the mouth, the ends hanging from the cheek and those from the mouth being tied together, the whole acting as a seton to establish an artificial fistulous communication with the mouth. This object will probably be secured in about a week or ten days, when the seton may be removed. The fistula in the cheek will then probably contract and close of itself; but if this does not take place the edges of the fistula may be cauterized by the galvanic, gas, or actual cautery, and thus cicatrization be encouraged. The operation may be repeated if required. A plastic operation may be attempted when these means fail.

I have known *parotid* salivary fistula follow upon the suppuration of the gland after fever in three cases; the orifice in all being small and placed behind the angle of the jaw. In none of these was it associated with any obstruction to Steno's duct. It was troublesome only from the trickling of saliva during mastication, though to one of the patients, who was a lady, this caused much annoyance. I tried the cautery in one of these cases, but without success.

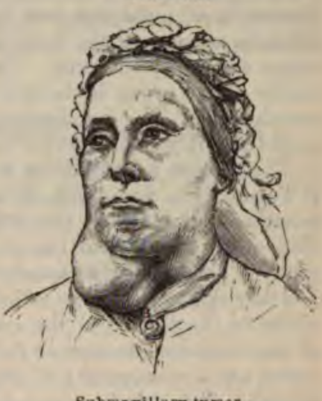
PAROTIDITIS OR "MUMPS."

This is a simple, although an infectious, disease, having a tendency to get well with simple fomentations of the parts, a saline purgative, and a mild tonic. It is occasionally metastatic to the testicle. When it follows upon a fever, it is a severe affection, and not unfrequently passes on to suppuration; such abscesses spread easily, the deep fascia covering them in forbidding a natural outlet except by burrowing. Salivary fistula in the neck may follow in such a case. Professor Crocq, of Brussels, believes this disease is the result of a stomatitis propagated along the duct of the parotid gland to the gland itself.

PAROTID AND SUBMAXILLARY TUMORS.

These have one peculiarity, viz., that they are almost always more or less cartilaginous —the ordinary form of tumor in this region being the fibro-cartilaginous—they, moreover, are mostly encysted, having a peculiar hard, elastic feel and botryoidal outline. They are generally imbedded in the structure of the gland, and vary much in their depth; tumors that appear movable and superficial, too often dipping well down into the tissues and thus increasing the difficulty of their removal. These simple tumors may grow to a large size, and stretch the skin greatly over them, and should always be removed; the earlier the better. In removing them, the surgeon should be careful to make his incision well down to the capsule, when he will probably be able to enucleate the growth. It is far better practice to do this, even with the application of a little force, than to be too free with the knife, for the facial nerve is generally in close contact with the tumor and the deep vessels are beneath. He should also always cut upon the tumor, dividing only such tissues as hold it down, taking great care too that the large vessels are, if possible, left uninjured. In deeply placed tumors, this removal by enucleation is still more necessary. When the tumor is large, there is always a strong probability that the facial nerve will be divided or injured, hence it is as well to prepare the patient for the fact. Fig. 193 illustrates the situation and external appearance of one of these tumors.

Fig. 193.



Submaxillary tumor.

Cancerous tumors of the parotid are likewise met with, but assume a very different appearance from the last. They are mostly infiltrations of the gland, fixed, diffused, and deep seated; they are, moreover, generally associated with paralysis of the facial nerve, differing in this way from innocent growths. Never should they be surgically interfered with.

The difficulty of deciding as to the removal of large growths in this position is very great, and the best guide is their mobility. Sir W. Fergusson, who had had more experience in these cases than any man of modern times, says, "If it were evident that the part slid freely over the subjacent textures, I should not hesitate about using the knife, whatever might be the bulk of the disease," &c.; "but if the tumor seemed fixed, its limits were not clearly defined, or an attempt to move it caused pain, I should not readily be induced to use the knife, however small the mass might be," and I endorse these views.

AFFECTIONS OF THE TONGUE.

Tongue-tie is occasionally met with, but not a tithe of the cases so ascribed are of this nature. It is due to a tying down of the tip of the tongue by the frænum linguæ, which prevents the infant from projecting the organ beyond the gums, thereby interfering with suckling. It is easily remedied by dividing the frænum perpendicularly downwards behind the gum with a pair of blunt pointed scissors, the point of the tongue being elevated with the finger, or a pair of dressing forceps applied beneath.

Wounds of the Tongue.

These are sometimes troublesome from hemorrhage, but, when the parts are brought together, the bleeding, as a rule, ceases; sutures should always be employed when gaping exists. If, however, a bleeding vessel be visible, it ought to be tied or twisted. The sutures must be put in deeply to draw the whole thickness of the divided parts together. On one occasion, owing to a neglect of this practice, I had to pare the surface of an old wound of the tongue that had passed through the half of the organ transversely, and then bring the parts together. The child was clearly unable to talk on account of the injury; yet after the operation, all was well. When bleeding is obstinate and the parts cannot be brought together, the cautery or perchloride of iron may be usefully employed. In exceptional cases the ranine artery may require a ligature. Ice in the mouth arrests slight hemorrhage.

Hypertrophy of the Tongue.

This is a troublesome affection chiefly from the mechanical obstruction which it causes, is chiefly found in young subjects, and is sometimes congenital. It has been ascribed to chronic inflammation of the organ, but that such is invariably the case appears doubtful. When it has existed for years, it may cause distortion of the jaws. It may involve the whole organ or only half. In a case I had under my care not long ago, this latter condition was singularly well illustrated. It is to be recognized simply by the increased size of the organ, no external evidence of disease usually existing. The enlargement, as a rule, is painless, though when the tongue cannot be kept in the mouth, the disease is distressing. It is not often amenable to treatment. In the case of a boy, æt. 6, who was originally under the late Dr. Addison's care at Guy's for a congenital enlargement of the organ, the perchloride of mercury in small doses reduced the size of the organ so as to allow of its return into the mouth, and, although several relapses took place in later years, the same treatment was repeated with equally good results. In a gentleman, at 20, who consulted me some years ago for enlargement of the tongue of twelve years' standing, attended with protrusion and all its evils, iodism induced by ten-grain doses of the iodide of potassium was followed within a week by the speedy disappearance of the affection, though at the time death appeared imminent from the excessive swelling of the organ caused by the drug. In other cases the removal of a wedge-shaped piece from the centre of the organ is the best practice; while to cut off the projecting portion is far less satisfactory. The application of ligatures to the lingual arteries to starve the disease might possibly be of service in such cases.

The tongue may likewise be the subject of *ichthyosis.* Sir James Paget, Mr. Holmes ('Trans. Clin. Soc.,' vols. ii and iii), and Mr. Morris ('Brit. Med. Journ.,' 1874) have recorded examples of the affection. Many have come under my notice. They have a disposition to pass into cancer, and the case from which Fig. 195 was taken was of this nature. When cancer attacks the ichthyotic tongue, it is generally of a virulent form, and any operation for its relief is too often followed by a rapid recurrence of the disease, either in the part or in the cervical glands. An ichthyotic tongue, therefore, should be at once removed as soon as the slightest evidence appears of its being the seat of cancer. Cases are also on record of *fatty tumors*, of *warty growths*, and congenital *pedunculated* growths, *fibro-cellular* and *adenoid tumor*, and *hydatid of the tongue.*

Glossitis.

Inflammation of the tongue when deep seated and general is a grave affection, as the swelling may be so sudden and severe as to threaten life by suffocation. In the sudden enlargements from the salivation of mercury or iodism, as in a case already given, these symptoms are at times seen, but, as a rule, they subside rapidly under local fomentation on the removal of their cause. If suffocation be threatened by the œdematous enlargement of the organ, free vertical incisions might be required, though I have not yet seen a case where such a practice was demanded. Inflammation ending in local suppuration is far more common; and, when an abscess has formed, the sooner it is opened the better. If it be situated at the root of the tongue, both deglutition and speaking will be interfered with; indeed, the abscess may mechanically so press upon the epiglottis as to close the larynx, and threaten life.

Local inflammation of the tongue may arise without any known cause, or from the contact of some irritating substance, such as that of tobacco. It may also follow a wound.

Treatment.—Fomentations to the part frequently applied, and an incision into the abscess as soon as it can be made out, are the best local means. Tonics after the use of a mild purge are also useful. When the swelling becomes dangerous by its pressure, the œdema may be dispersed by an incision or puncture, but the surgeon need be in no hurry to adopt this practice; it is rarely needed. My late colleague, Mr. Poland, had a case in which incisions were followed by very serious hemorrhage. The application of leeches to the organ when projecting has been followed by rapid relief.

Aphthous Inflammation

of the tongue and superficial ulceration are not uncommon. It occurs in children chiefly from alimentary irritation, and is curable by the chlorate of potash internally in five- or ten-grain doses, like aphthous stomatitis.

Simple or Dyspeptic Ulcer

of the tongue is a rare and very obstinate affection. The few cases that I have seen of it have been in adults in whom considerable disturbance of the digestive apparatus existed. In one, the patient passed lithic acid in such abundance as to startle me. He used to bring it in spoonfuls weekly. The ulceration may be extensive, but always superficial, and the tongue is usually glazed with it and often red. To the touch it does not feel hard.

Treatment.—The only sound treatment is a soothing one. The bowels should be attended to by means of a mild purgative such as castor oil, and rhubarb and magnesia, or alkalies given, such as the bicarbonate or chlorate of potash in gentian, calumba or bark. The diet should be regulated in the most careful manner, and all food forbidden that can possibly irritate. Milk, when it can be taken should be allowed. Beer and spirits are generally injurious; but wine may be allowed when necessary. Locally, the chlorate of potash lotion is the best. Caustics and other stimulants are rarely required.

These cases are not to be mistaken for the syphilitic or condylomatous affections of the organ which are less superficial, more raised and indurated, and are, besides, usually associated with patches on the throat, lips, or cheek, and other constitutional symptoms; nor with the fissures or ulcers that are often found at the side of the tongue, due to the irritation of a stump or tooth.

Deep-seated Ulcers of the Tongue.

These may be *simple*, *syphilitic*, or *cancerous*. The first is very uncommon, and usually the result of a local abscess. It can be known by the sharpness of the edges of the sore, the absence of induration, and the fissured aspect of the ulcer. It has a tendency to recovery.

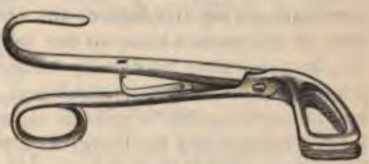
The deep-seated syphilitic ulcer is generally the result of a breaking down of a gummatous tumor in the thickness of the organ. As a tumor, it appears as an induration of the part; and as an ulcer, it appears deeply excavated with irregular but not infiltrated or everted edges. It is slow in its progress and not so painful as cancer. It is usually found also with a history or with symptoms of syphilis, and occurs chiefly in the body of the tongue. It can be mistaken for a cancer, and I consider most of the cases of so-called cured cancer of this organ are of this nature.

Cancer of the Tongue

is usually epithelial, and may occur in a person the subject of ichthyosis. It is most common between forty and sixty years of age; and, like cancer of the lip, is more frequent in men than women, in the ratio of five to two, generally commencing in, and confined to, one side of the organ; an analysis of fifty-five cases ('Just. Schmidt's Jahrb.,' 1860) proving that it involved both sides only in nine. It begins more frequently as a crack or ulcer than as a wart, and soon causes pain. It increases with variable rapidity, though the majority of patients seek advice only after it has existed a few months. It is usually recognizable by the irregular surface of the sore, its indurated and often everted edges, its hardened base, and sloughing surface. As time goes on the glands beneath the jaw become enlarged, the disease infiltrating all the tissues as it increases, and the patient's powers becoming enfeebled; hemorrhage from some large vessel too often in the end destroys life.

Treatment.—It is now admitted that the sooner the disease is removed the better, as there seems good reason to believe that it is at first a local affection, and that after its removal a cure may be obtained. If this end be not secured, much benefit will be gained by the operation, as it relieves a patient for a time, from a most distressing and exhausting affection; and, should a return take place, it is more likely to do so in the glands than in the part—while death, under these circumstances, is less painful. The operation, moreover, is attended with marvellously little risk to life, and is followed by improved articulation even when the whole organ has been removed. In the case figured (Fig. 195) the man could speak as well after as before the operation. There are only two modes by which this removal *should* be effected, *excision* and the *écraseur*. Caustics are painful and uncertain, consequently have been rightly abandoned. The ligature is painful and tedious, and, beyond the freedom from hemorrhage, it has no advantages; and in this is only equal to the écraseur. In excision the surgeon using knife or scissors must be careful to remove the whole of the diseased part, cutting well beyond the limits of the tumor. At the same time, when a portion of the organ only need be sacrificed, no more should be removed than necessary. It is wiser, however, to remove too much than too little.

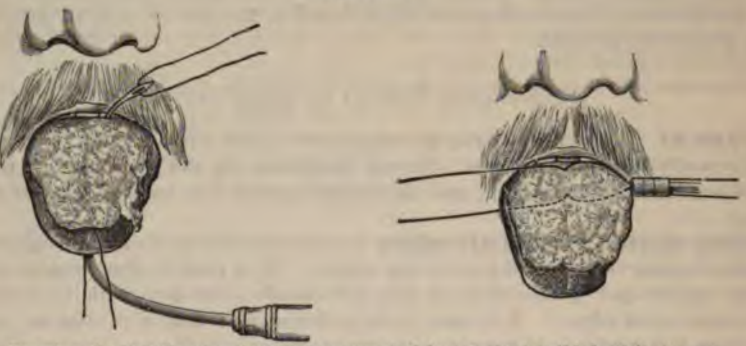
Fig. 194.



Tongue forceps.

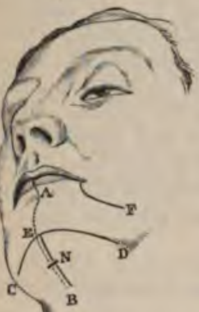
When the disease is limited and in front, excision may be employed, for with the tongue held well out by a suitable pair of forceps (Fig. 194), or by a ligature passed through the tip, all vessels can be tied or twisted and bleeding controlled. When the galvanic écraseur, or écraseur wire heated by the galvanic battery can be obtained, no better means can be found for removing small or large portions of the tongue, and since I have employed them I have given up excision. With pins put in to isolate the growth, and the wire carefully adjusted behind them, any sized mass may be readily removed by a bloodless operation. Some prefer, however, the ordinary wire écraseur. Both instruments are good. The amount that can be removed through the mouth by these means is measured only by the appliances the surgeon has at his command to fix its posterior boundary. In the case figured above more than the anterior two-thirds of the tongue were removed, and, by means of the curved needle shown in the drawing, no difficulty was experienced in passing the ligature, or in removing the organ.

Fig. 195.



Drawing showing the operation for the removal of the anterior two-thirds of the tongue.

Fig. 196.



Illustrating the different operations for the removal of a tongue.

When the diseased tongue cannot be excised with safety, or its base isolated and surrounded with certainty, through the mouth, various expedients have been suggested. Professor Syme divided the lower lip and jaw in the median line to give room for the operation (A to B, Fig. 196). Regnoli, of Pavia, made an incision from the hyoid bone to the chin, and two lateral cuts from the anterior extremity of this along the lower border of the jaw (B to E and C to D, Fig. 196), dividing through to the mouth all the tissues that connected the tongue with the lower jaw at the symphysis, thereby giving abundant room to draw the tongue downwards. Nunneley, of Leeds, introduced beneath the jaw, between its base and the hyoid bone, a sharp-pointed curved knife, four inches long, and brought it out in the mouth at the frænum linguæ (N, Fig. 196). With a probe guided upon this knife he then drew through the wound the wire rope of the écraseur, drawing a good loop through the mouth and withdrawing the probe, the two ends of the rope hanging beneath the chin. He then seized the tongue with forceps, forcibly pulling it out of the mouth, and pushed through the base of the tongue three long and strong pins, making their ends appear in its upper surface near the base, and behind the disease. He then passed the loop of the écraseur behind the pins and drew it tight, thus completely encircling the whole organ. The process of removal then went on. Sir J. Paget improved upon this, in doing away with the submental puncture, and giving freedom to the tongue by dividing the soft parts that hold it down at the floor of the mouth close to the bone, thus allowing the organ to be pulled well forward. At the same time he rightly insisted that care should be taken to divide the tongue perpendicularly through its thickness, and not obliquely; this point, however, is guaranteed by the introduction of pins as already mentioned. Collis, of Dublin, instead of using the knife as suggested by Paget to divide the sublingual tissues, employed the écraseur. He has, also, advised that the cheek be laid open from below its angle to give room for manipulation when the disease is far back (F, Fig. 196). By one or other of these means, room can be obtained to free the tongue from its attachments, to isolate the growth by pins, and remove it by the écraseur—wire rope being used when the galvanic cautery écraseur cannot be obtained. I believe Nunneley's method to be the best, using the galvanic cautery écraseur when the disease is extensive. To isolate the disease, I have found the curved needle as seen in Fig. 195 introduced beneath the chin (N, Fig. 196) through the base of the tongue, behind the disease, to be very valuable.

When the disease is placed anteriorly, the introduction of pins through the mouth and the écraseur, are all that is required. When more room is necessary, Collis, Paget, or Nunneley's plans may be resorted to. When the disease cannot be isolated by these means, Syme's operation must be had recourse to, in which case it will be well to act on the suggestion of Sedillot's, and make the section of the jaw-bone irregular, to allow of a better adaptation of the segments afterwards than can be insured when the line of division is vertical. The use of the knife had better be confined to the removal of small tubercles in the front of the tongue; all larger pieces being removable by the écraseur with equal facility, and with a smaller loss of blood.

When this disease cannot be removed, palliatives must be employed, and, among these, the removal of all teeth on the affected side of the mouth is most important.

Ligature of the lingual arteries has been practised by M. Demarquay and others for the purpose of starving a cancerous tongue, occasionally too with a good result; yet such a proceeding is only applicable when the removal of the organ cannot be entertained.

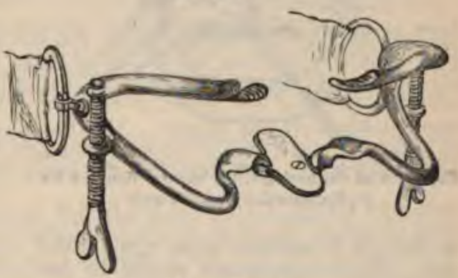
Division of the gustatory nerve has likewise been practised with success by Hilton (1850), Moore (1861), and others, for the *relief of pain* in these cases. The nerve can easily be divided by an incision made between the last lower molar tooth and the anterior pillar of the fauces, behind, below, and parallel with, the alveolar ridge, as it descends from the coronoid process.

Fissures of the Palate.

The hard and the soft palate are liable to fissure, partial or complete, or both palates may be involved. It may be that the fissure appears as a mere notch in the alveolar process, in the line of junction of the superior maxillæ with the intermaxillary bone as is seen so commonly in harelip, or, it may pass backwards towards the velum; still on the other hand, the soft palate may show only a bifid uvula or a complete fissure. The fissures in the hard and soft palates are always in the middle line, although where they involve the alveoli, they diverge as they involve one or both intermaxillary bones; in fact, they invariably follow the line of suture, as seen in Fig. 165. Fissure of the soft palate alone is more common than that of the hard. Yet it is very rare for the intermaxillary bone to be so displaced, as seen in Fig. 171, without fissure of the palate. These malformations, when severe, give rise to much difficulty in sucking and deglutition, the food passing through the nose. They likewise interfere much with speech. Partial fissures are of little importance.

Treatment.—When fissure of the palate coexists with harelip, the lip may be operated upon as usual irrespective of the fissure, though it will be advantageous for the patient to wear subsequently a Hainsby truss (Fig. 174) as the steady pressure of the pads has doubtless a good influence in bringing together the bones. Operations for the repair of the fissure have, till recently, been put off till the child was of an age to give assistance to the operator. Billroth was the first to operate in infancy, and did so with success on a child, twenty-eight weeks old, in three operations. In 1868, Mr. Thomas Smith introduced to the profession a gag (Fig. 197) that holds the jaws open and depresses the tongue, enabling the surgeon (with the patient under the influence of chloroform) to undertake the operation at a very early period; indeed, Mr. Smith has quoted cases where he operated at three years of age ('Med.-Chir. Trans.,' 1868; 'St. Barth. Hosp. Rep.,' 1871). It may generally be undertaken at the age of five, in a healthy child, and I have performed it successfully at four years of age.

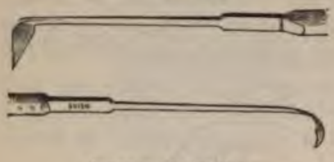
Fig. 197.



T. Smith's gag.

Roux was the first who practised the operation with advantage, having in 1819 successfully treated a medical student for cleft palate. Dr. Mason Warren, of Boston, did also much towards encouraging the practice; but, in this country, there is no doubt that to Sir W. Fergusson is due the credit of having demonstrated the value of the operation and of suggesting improvements therein. In his chief paper, published in 1845 ('Med.-Chir. Trans.'), he showed "how the *levator palati* on each side had such free and uncontrolled action that, whenever excited, it drew the margin of the cleft outwards and upwards, and so tugged upon the stitches put in by the surgeon that ulceration in their sites was a most probable result." He therefore suggested the division of this muscle in all cases, and that of the palato-pharyngeus in some. He did this by means of a curved knife (Fig. 198) passed through the fissure, so that its point can be laid on the tissues immediately above the soft velum, midway between its attachment to the bones and the posterior margin, and about half way between the velum and the lower end of the Eustachian tube. The point is then thrust deep, and carried half an inch or more backwards and forwards so as to cut the levator palati. By these means, the palati is paralyzed for a time, and so repair goes on with greater certainty.

FIG. 198.



Fergusson's knives.

For fissures of the hard palate much has been done in more recent times. Dr. Mason Warren, in 184 described the process of separating the hard from the soft palati with the view of its closure, though it has been left to Langenbeck, Billroth, Pollock, Avery, Lawson Tait, Annandale, T. Smith, and others, to perfect the process.

The operation.—Chloroform is not necessary in a patient old enough to understand the necessity of being still and assisting the surgeon. In young children, with Smith's gag, it is an advantage.

The recumbent position, with the head sufficiently thrown back, is probably the best, although some surgeons make the patient sit. The operator should stand on the patient's right side, or in front. The steps of the operation have been hitherto as follows: Pare the edges of the fissure; pass the sutures; paralyze the muscles; and fix the stitches. To pare the edges, a blunt-pointed bistoury is generally used, and a thin border of mucous membrane cut off from below upwards, the bifid uvula being held by a tenaculum-pointed forceps (Fig. 199). The incision also should be made as clean as possible. When it is made from above downwards, a sharp-pointed bistoury is needed. To pass the sutures, a corkscrew needle may be employed, or a curved needle flattened laterally (Fig. 200), with a slit in it for an eye, or an eye in the end. The lowest suture should be inserted first and both ends held—this practice facilitating the introduction of the others. The best material for sutures is fine gut; Mr. Smith uses horsehair for the lower stitches. I have rarely used anything but gut for all plastic operations since the year 1860, taking the precaution to select and to soak it in water for some minutes before using it. During the last two years I have as often used silk as not.

FIG. 199.

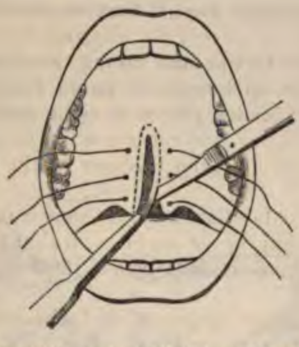
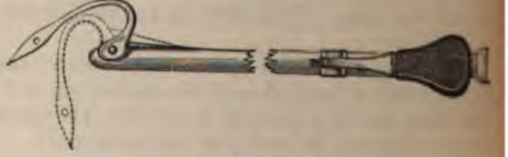
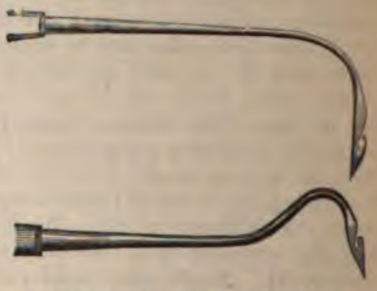


Fig. showing the paring of the edges of fissure after the introduction of the sutures.

FIG. 200.



Brook's needle.



Needles employed in fissured palate.

If Sir W. Fergusson's plan of paralyzing the muscles be employed, it should be, as he advises, as a preliminary step to the operation. If Sedillot's or Pollock's plan be followed (Fig. 202), it may now be done by inserting a knife through the velum about a third of an inch from the highest suture, and cutting along the posterior edge of the hard ate towards the free margin, but not through it. This is the course I have until ently adopted. The two pillars of the fauces may then be snipped with scissors. The ures have then to be fastened, and the best plan is, to run a perforated shot over the and clamp them, tying the ends of the gut in a knot to prevent the possibility of their pping. I usually begin at the highest. Care should be taken not to draw the stitches tightly. The parts should be sponged as little as possible, and the less manipulation re is the better; any irritation causing so free a secretion of mucus as to interfere atly with the surgeon's proceedings. Rapidity in operating is consequently an advange. When the parts require to be cleansed in the adult, iced water may be used as a rgle; and with a child under chloroform, the stitches may at times be inserted and the edges pared before any cleansing is required. In deep mouths where difficulty is experienced in passing the sutures, a clever manœuvre suggested by Avery may be called for, and is illustrated in Fig. 202; one end of the gut C is pulled through the soft palate and the end passed through a loop of silk (A) inserted on the right side; on pulling the loop the end C will be drawn through the right side. When silk is used, the double reef knot as shown at the lower part of Fig. 202, and generally adopted by Fergusson, is very serviceable.

Fig. 201.

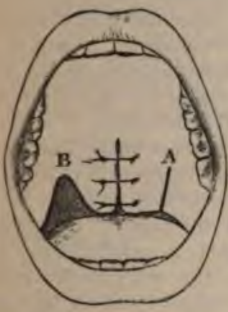
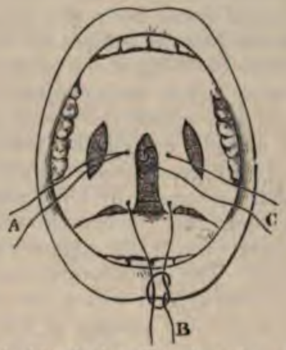


Fig. illustrating line of incision employed to relieve tension of the palate after the edges have been adjusted.

Fig. 202.



A. Avery's plan of passing sutures.
B. Fergusson's plan of fastening sutures.

Lastly, however, I have much simplified the operation, merely by altering its steps; that is to say, I have first introduced sutures through the soft palate, taking care to do so a quarter of an inch from the free border of the fissure, and secondly pared the edges, employing for this purpose a pair of scissors with short blades placed at right angles to their shanks or a knife. By this practice, the introduction of the sutures is an easy proceeding, and, consequently, very rapidly effected, and the bringing together of the pared edges can be readily accomplished.

To relieve tension of the parts I now divide the soft palate laterally, as shown in Fig. 201, A, the side cuts subsequently gaping, B, so as to appear as arches; so that in this way the muscles of the palate are completely paralyzed and the soft palate itself appears as one large uvula.

I have performed the operation already described on many occasions, and with success. In none was there ever a pin-hole left. Its simplicity is very striking. It cannot, however, be applied in all cases.

The stitches may be left in for five, ten, or even fourteen days, the amount of irritation being the guide to their removal. When union has taken place, the sutures only act as irritants, and in this as in all plastic operations they should be removed as early as possible with safety. During the process of repair the patient may freely take soft food, swallowing by no means tending to separate, but, on the contrary, to close the wound. Stimulants may be given when desirable. The operation, however, should only be undertaken in healthy patients, whereas in the feeble it is almost sure to fail. After the operation the patient's friends should not be led to expect that an immediate change for the better will be traced in the voice, as such is never the case, indeed a long interval of time as well as a process of education is necessary to acquire this result, although in many instances, the improvement is very great. How far an operation in infancy tends in this direction has not yet been proved, sufficient experience in these early operations, as yet, not having been acquired. If a small orifice near the hard palate be left after the operation, no necessity exists to interfere again, because it is a clinical fact that they have a strong tendency to contract, and, the younger the patient, the greater the probability of complete closure.

Mr. Tait believes, and I think rightly, that if the muco-periosteum of the hard palate be elevated with a raspatory from the semilune of the palate bone, the tendinous attachment of the tensor palati will be raised with it, and thus paralyzed, thereby doing away with the necessity of any such division of muscles as practised by Pollock or Fergusson, and diminishing the risk of the pin-hole orifice at the junction of the hard and soft palates. He advocates, moreover, two or more operations, viz., the hard palate to be first closed and the soft after some months' interval.

Fissures of the hard palate.—These are to be treated on similar principles to those of the soft, the great point of difference consisting in the separation of the soft parts with the periosteum from the bone. For this purpose, Langenbeck's instrument is the best—a kind of small hoe; with this, after making an incision down to the bone along the edge of the gum, he scrapes all the soft parts from the bone down to the free border of the fissure, the covering of the palate then hanging as a free curtain. Care is required in this proceeding not to tear or injure the soft parts, and more particularly the anterior and posterior portions where the vessels enter. The other steps of the operation are such as have been already described. Since November 22, 1873, however, Sir W. Fergusson has adopted with great success a method of dealing with fissures of the hard palate which was originally proposed by Dieffenbach in his 'Operative Surgery,' 1845. There is a want of evidence that the operation was ever previously performed, and Sir W. Fergusson was not aware even of the suggestion when he published his paper ('Brit. Med. Journ.,' April, 1874). The operation, as seen in Figs. 203 and 204, is as follows:—

Holes are first drilled with a curved brad-awl through the margins of the hard palate (Fig. 203, C) for the passage of the threads, while the palate itself is then cut through with a chisel in a line parallel to and about half an inch from the edge of the cleft (Fig. 203, B), such a step being much facilitated by acting upon Mr. Mason's suggestion of previously drilling the bone with a curved brad-awl (Fig. 203, A). This loosening of the margins of the hard palate, allows the borders of the cleft to be brought together along its whole length, after the margins have been pared and the stitches twisted (Fig. 204). When any difficulty is experienced in approximating the loosened portions of the hard palate, the bones may be separated and prized down by means of the chisel, and the lateral opening plugged with lint. Indeed, if the bones are well loosened and the lateral openings well plugged, no sutures are required through the hard palate, the parts falling well together. The operation is very valuable, and in my hands has been successful.

FIG. 203.

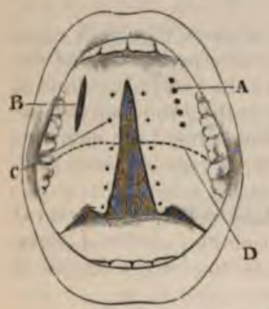
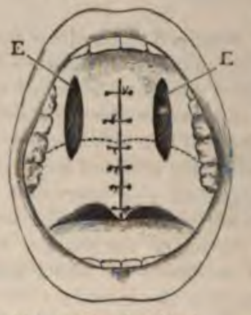


FIG. 204.



A. Preliminary punctures with awl to give line for chisel.
B. Incision through bone completed by chisel.
C. Holes bored through hard and soft palate for sutures.
D. Junction of hard and soft palate.
E. Lateral openings subsequently filled up by granulation.
These drawings were kindly made for me by Mr. W. Rose.

When operative relief cannot be given in these cases or has failed, the patient may be handed over to an experienced dentist, for with a good obturator of gold or other material, great comfort can be given, and even a velum may be supplied of India rubber. On these points an article in 'Holmes's Surgery,' by my friend Mr. James Salter, may be consulted with advantage. Operative relief, however, is always superior to instrumental, as in the latter the patient is entirely dependent upon the mechanist.

Wounds of the palate are met with in practice from patients falling with pointed instruments in their mouths, such as pipes, sticks, spoons, &c. Small wounds need no attention, and generally do well; lacerated wounds dividing the velum, should be brought together by sutures; but where they have been left and a separation ensues, the edges may be subsequently pared and brought together as in fissured palate.

Perforations of the hard palate are generally due to the exfoliation of bone, and no plastic operation is of use. The proper treatment of such cases is to close the aperture by an accurately fitting plate of metal or vulcanite attached to the teeth, and

mmediately below the palate, but making no pressure upon the edges of the hole
the effect of a plug is to enlarge the aperture by absorption.

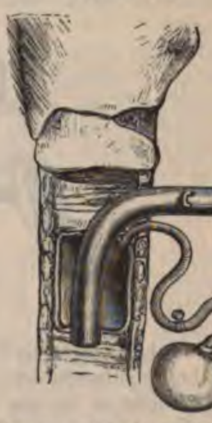
rations of the hard and soft palates.—These are very common as a
syphilis, and appear as *superficial ulcerations* about the pillars of the fauces and
of the velum. They are often preceded by an erythematous redness and take on
ng action in cachectic subjects. They appear, too, also as *mucous patches* at
e of syphilis, congenital or acquired, involving at the same time the tonsils,
kc. They appear as slightly elevated spots covered with ashy or yellowish mem-
neath which some slight ulceration may be found. Frequently they are asso-
th other symptoms. They are to be treated as part of a constitutional disease,
l treatment being applied as the aspect of the surface may demand. Local
ts, as alum and borax, are, as a rule, of value, and also nitrate of silver or iodo-
n local stimulants are needed.

nous ulceration of the palate.—This is a distressing affection, the ulcer-
ion being often so rapid as to destroy within a few days the whole fauces. It is
et with in the young and feeble. In other instances, it is slower in its action
qually destructive, gradually eating away all the soft tissues even to the hard
d pharynx, and is often mistaken for syphilitic disease, or *vice versâ*. The his-
he case alone can determine the point. Tonics and local stimulants are, as a
only requisite treatment; good food, of a liquid nutritious kind, being supplied
ance. When gargles are difficult to use, carbolic acid lotion, Condy's fluid, or
tion, a drachm of the tincture to a pint of water, may be scattered over the parts
spray producer. In certain cases, a powerful local caustic such as nitric acid
vith a glass brush, tends to arrest the action. As a result of ulceration of the
te, it sometimes happens, that the palate becomes completely adherent to the
part of the pharynx. In one case under my observation, there was only an open-
ize of a crow-quill between the pharynx and the nose, which I subsequently en-
d kept dilated by means of tents with great advantage. In another, a central
isted, leading down to the œsophagus and upwards to the nose. In this case,
nt experienced great difficulty in deglutition. He had to eat with the greatest
otherwise the food would pass into the larynx. Cases are on record in which it
found necessary to enlarge this opening, and even to open the trachea to main-
Under such circumstances it is probably a wise maxim always to open the
before any operative interference is undertaken in order to enlarge the pha-
pening.

ors of the palate or new growths are rarely seen. I have met with several
warty growths, simple and malignant, and in 'Guy's Reports,' 1869, I have
an interesting case of myxoma which covered the whole of the hard palate, and
l by removal.

gust, 1872, I also removed from the soft palate of a man, æt. 38, a globular
mor of six years' growth the size of an unshelled walnut, which had been for
s seriously interfering with deglutition and respiration.
ted the growth after making a free incision into its
aving previously been obliged to perform tracheotomy
nt suffocation. In this case, I employed Dr. Tren-
g's tracheal tampon (Fig. 205), and found it of great
It effectually prevented the entry of blood into the air-
allowed the patient to be kept under the influence of
m, and enabled me to complete the operation with
nd safety. (*Vide* 'Med. Times and Gaz.,' May, 1872.)
ajority of cases of tumors that involve the palate,
om the gums or upper jaw.

FIG. 205.



Section of trachea, with Dr. Trendelenburg's tracheal tampon.

gation of the uvula from inflammatory œdema is
s a very acute affection. It comes on rapidly at
d gives rise to suffocative symptoms. I have seen a
hich the uvula became as thick as a finger and rested
ongue with its tip forwards, and of this, there is a
at Guy's. An incision into it, or several punctures,
relief; but, as a rule, it is better to cut off the lower
e organ. Elongation from other causes is far more
and is generally to be recognized by the peculiar
cough and husky voice to which it gives rise, the end

of the uvula acting as a constant irritant to the epiglottis or glottis. There is reason, indeed, to believe that not a few of the cases of supposed laryngeal irritation are due to this cause. The removal of the lower half of the organ by means of a long pair of forceps or scissors, rapidly gets rid of all the symptoms.

A polypus composed of simple mucous membrane may grow from the uvula. I have removed one from the tip, and another from the base. They give rise to symptoms identical with those of elongation. I had also a case under observation in which the polypus had so long a peduncle as to fall at times into the orifice of the larynx, and excite a violent spasmodic cough, but the man refused to have it removed.

Tonsillitis.—As an acute affection this is known as *quinsy*, and is characterized by the rapid swelling of the part, acute pain, foul tongue, and fever. Within three days, or longer, suppuration may appear, and, when suffocative symptoms make their appearance, the surgeon's interference may be demanded. At times, life may be sacrificed by the want of surgical attention. Some years ago, a case came before my notice, where a child, two years of age, was suffocated from the bursting of a tonsillitic abscess.

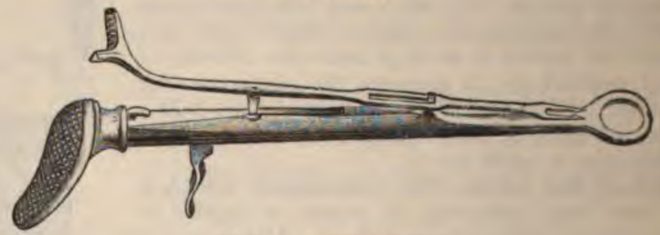
Great redness and rapid swelling of the organs are the chief local symptoms.

TREATMENT.—Fomentations externally, the inhalation of hot steam, and saline purgatives, are essential points of practice. As to drugs, none seem to have so powerful an influence over the disease as guaiacum, an ounce of the mixture with some compound spirits of ammonia being the best form, and when this is employed early, suppuration rarely appears. When an abscess has formed, the sooner it is opened the better. The best mode of doing this is to cover a straight bistoury to within an inch of its point with lint, and having depressed the tongue with the finger, to introduce it into the swollen tissue, making a free incision; care being taken not to direct the point of the knife outwards, but directly backwards. Should pus appear behind the pharynx, it must be let out. Tonics, such as quinine or iron, should then be given, with good food; a speedy convalescence, as a rule, ensues.

Chronic enlargement of the tonsils.—This is frequently met with in feeble children as well as in adults living in marshy and damp localities. It is often a sequel of the more acute inflammation, but as often as not, it appears without any such cause. There is reason too to believe that some of the cases of so-called chronic enlargement of the tonsils are due to new adenoid tonsillitic growths. On two occasions when removing these enlarged organs, I have turned out distinct tumors the size of nuts embedded in and surrounded by tonsillitic tissue which were distinctly glandular, and, under the microscope, could not be distinguished from tonsil tissue. In both cases the enlargement was unilateral. Bilateral increase is probably always due to hypertrophy or chronic inflammatory enlargement.

This enlargement gives rise to a peculiar nasal twang in speaking and to a most distressing snoring, the patient, as a rule, having a half-opened mouth night and day. It is commonly associated with irritable mucous membranes generally. I have seen it so troublesome in a child three and a half years old as to prevent the deglutition of solid food, the patient having lived for six months on liquid nourishment. Tonic treatment is essential in all these cases; so is a *simple* nutritious diet. A mixture of bark and soda at first is the best to soothe and give tone to the digestive apparatus, cod-liver oil, quinine, and iron, being subsequently prescribed. When the organs are congested from inflammation, the glycerite of tannin is a good application, and, when simply enlarged, a mixture of glycerine and tincture of the perchloride of iron, in equal parts, or Liq. Iodi, should be used. It is wise also to give the patient some solid iodine in a perforated box to stand on

FIG. 206.

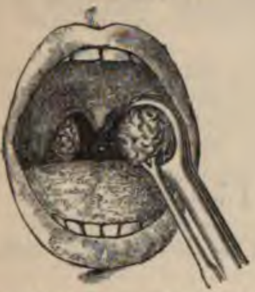


Guillotine prepared for use.

a shelf in the day as well as in the sleeping room; the gradual evaporation of the iodine seeming to purify and iodize the air in a beneficial manner.

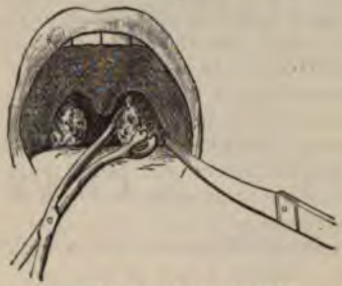
When the glands are white and hard, all hopes of curing them by medical treatment are at an end; excision is the only thing to do. For this purpose the guillotine (Fig. 206) is the best instrument to employ when it is at hand, otherwise a pair of vulsellum forceps and a bistoury must be used, guarding the base of the latter with lint or strapping to protect the lips (Fig. 208).

FIG. 207.



Operation on tonsil with guillotine.

FIG. 208.



Removal of tonsil with knife.

CALCULUS IN THE TONSIL.

In 1860, such a case came under my care. A man, æt. 38, after having suffered from enlargement of the right tonsil for a year and a half, expectorated a calculus the size of a nut, the expulsion of it having been preceded for three days by severe local pain and immediately beforehand the sensation of something having given way in the parts. When I saw him there was a distinct cavity in the tonsil. The stone was hard and ragged, and appeared to be made up of phosphatic salts; but the patient claimed the stone, and therefore it was not examined. Small calculi, the size of mustard seeds, are more common, and are supposed to be calcified tuberculous deposits. In Guy's Hosp. Mus. (Prep. 1677^{50}) there is a specimen analyzed by Dr. Babington which consisted of phosphate of lime.

CANCER OF THE TONSIL.

This rapidly fatal affection happily is rare, and has not received much attention. It may appear as a primary or secondary affection, and in the encephaloid or fibrous form. The *former* being the more frequent and rapid in its course, destroys life mechanically by secondary glandular enlargement, as well as by pharyngeal and laryngeal obstruction—the *latter* is seen mostly as an ulceration, and proves fatal by exhaustion. I have in one case seen this disease cause death by sudden and violent hemorrhage owing to extension to and perforation of the internal carotid artery.

This affection begins as an ordinary enlargement of the gland, but more rapid in its growth, and is mostly attended by early enlargement of the lymphatic glands at the angle of the jaw, and subsequently of those of the neck. When it ulcerates, the ulcer assumes the indurated jagged appearance of a cancerous sore, not unlike the deep syphilitic sore after the breaking down of a gummy tumor. It has, however, a more indurated base and border than the syphilitic. It attacks men mostly of middle age, but I have had under my care a sweep only seventeen years of age, with the hard form. I have the records of three other cases in males, aged respectively 49, 62, and 65.

TREATMENT.—Palliative treatment is probably the best to adopt, although Dr. Cheever, of Boston, has proved that the tonsil may be successfully extirpated by external incision ('Boston Med. Surg. Journ.,' 1871). Its removal from within seems almost hopeless, whether by caustics—Maissonneuve's plan—the écraseur, or enucleation. I attempted the latter in one case only with partial success—and the operation prolonged life.

Dr. Cheever performed his operation through an incision made below the angle of the jaw of three and a half inches, along the anterior border of the sterno-mastoid muscle, with a second incision extending along the lower border of the jaw. The flaps were reflected and a large gland enucleated. The digastric, stylo-hyoid, and stylo-glossus muscles were cut—the fibres of the superior constrictor being divided upon a director. The pharynx was opened. The finger of the operator was then swept round the diseased tonsillitic mass which was enucleated. The hemorrhage was free though not excessive, and twelve ligatures were applied. A steady convalescence followed. "The facility," adds Dr. Cheever, "with which the tonsil can be enucleated with the finger is surprising." This operation may probably be justifiable and beneficial in those cases before the glands are too far involved. For further information on this subject, reference may be made to the article "Amygdales, No. 2," 'Dictionnaire de Médecine,' 1865, and to Poland's article, 'Brit. and Foreign Review,' April, 1872.

CHAPTER XIII.

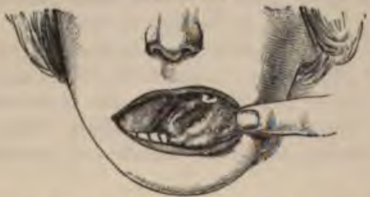
DISEASES OF THE GUMS, JAWS, TEETH, PHARYNX, AND ŒSOPHAGUS.

EPULIS.

UNDER this term epulis are included, rightly or wrongly, most of the tumors of the gums—hypertrophic, polypoid, or diffused—simple outgrowths from the gums, due to the irritation of a carious tooth or stump, papillary, fibrous, fibroplastic, myeloid, epithelial, and cancerous tumors.

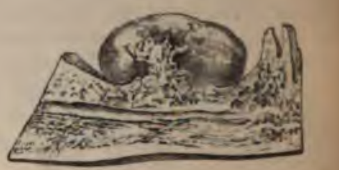
The true or fibrous, fibroplastic, and myeloid epulis (for these elements enter in different proportions into all the benign forms of epulis) are diseases chiefly of the periosteum (Fig. 209), and are rarely cured without removal. At times, however, they invade the bone (Fig. 210), the endosteal membrane which lines the bone being continuous with the periosteal covering it. They may appear as simple fleshy outgrowths of the gum about a tooth, and develop into a large mass of a firm or semi-elastic tissue. At a later stage, this mass may ulcerate and break down.

FIG. 209.



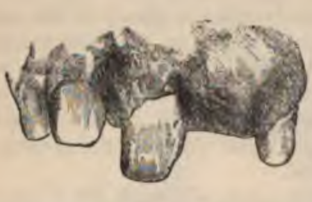
Fibrous epulis from gum. Drawing, Guy's Hosp. Mus., 271^{10}. Mr. Birkett's case.

FIG. 210.



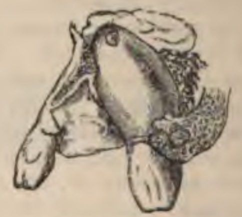
Epulis springing from bone. Mr. Key's case.

FIG. 211.



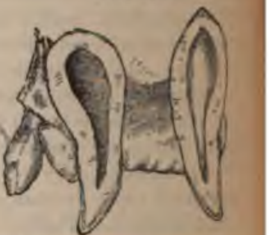
Front view of tumor of alveolus. Due to hypertrophy and dilatation of tooth fang.

FIG. 212.



Odontome after removal.

FIG. 213.



Section of odontome, showing expanded thickened root of incisor tooth.

In exceptional cases, a tumor that appears to be an epulis, results from the abnormal development of a tooth; this was the case in a boy, æt. 11, from which Fig. 211 was taken, the expansion of the alveolus having arisen owing to the development of an odontome of the root fang of an upper incisor tooth which had been growing for three or four years.

Fig. 211 illustrates the swelling of the gum before the removal of the disease; and Fig. 213, a section of the odontome. My friends, Messrs. Salter and Moon, informed me that this is a unique case. In the diagnosis of such a case, the protrusion of the crown of the tooth becomes a valuable guide.

TREATMENT.—The removal of the disease, of the teeth or stumps that are involved in it as well as of the bones with which it is connected, is the only sound practice to adopt. A good pair of cutting pliers, which will nip off as much of the alveolar process as seems involved, is the best instrument to use, a small hand saw having marked out vertically the limit of the incision. When the bone is not removed, a return of the disease is almost certain.

A *cancerous* disease of the gums puts on precisely similar appearances to those seen in similar diseases of the fauces, face, or tongue—an irregular, excavated, ulcerating surface, discharging fetid pus, associated with pain, and glandular enlargement marking its true nature. Most of the cases of cancerous epulis are epithelial. The benign form of epulis is generally an affection of young life, and the cancerous of the old and middle-aged.

Polypus of the gum or outgrowths of gum structure, are due to the irritation of carious teeth or to uncleanly habits. They can be cured by the removal of the growth and its cause.

Vascular tumors are met with on the gums and generally found between the front teeth. They are sometimes but not always associated with carious teeth. The outgrowth is usually small and more or less pedunculated, bleeding on the slightest manipulation. The vascular tumor occasionally presents more the features of a nævus. I have destroyed many of these growths by means of the galvanic cautery with success, but they can be removed by the knife or any caustic. When a carious tooth appears to be the cause of the disease it should be at once removed.

Abscesses about the gums are very common, and are frequently the result of disease of the teeth. Dentists tell us, however, that these gum-boils rarely induce any disease of the bone, though they sometimes arise from it. When connected with a carious tooth, and are of long standing, nothing but the removal of the tooth will effect a cure. When associated with disease such as "necrosis" or death of the bone, the removal of the dead portion is an absolute necessity.

NECROSIS OF THE JAWS.

This is a common affection as a consequence of one of the exanthemata, or some other fever, and is now fairly recognized. It is more common in children than in adults. As a rule it appears on the decline of the fever, with pain and swelling about some portion of the gums, and rapidly passes on to suppuration and death of the bone. The necrosis, however, is generally confined to the alveolus, in exceptional instances only it involves the body of the bone. Both jaws are equally liable to the affection. In the 'Guy's Hosp. Reports' for 1869 I recorded a series of cases to illustrate these points. In one case, narrated in detail, that of a woman æt. 25, who in infancy had lost a large portion of her upper jaw after measles—the lower jaw had grown up to fill in the deficiency in the upper. It was nearly one inch higher in its vertical measurement on the right side than the left; it seemed, indeed, as if the lower jaw had grown upwards for want of the regulating influence of the natural pressure which the teeth of the upper jaw must exert upon those of the lower when in contact with them. I have recently seen a similar case where the increase of growth had taken place in the upper jaw, in consequence of a deficiency in the lower.

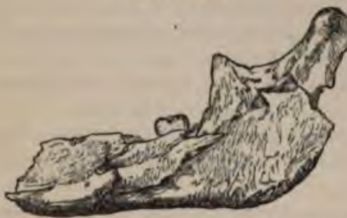
Necrosis of the jaws, as a result of the phosphorus poison, is now rarely seen, in consequence of the common phosphorus being less frequently employed than formerly in the making of lucifer matches. Dr. Bristowe, in his report to the Privy Council in 1863, clearly showed that it is to its influence the disease is to be attributed, *the amorphous phosphorus* being harmless. The first notice of the affection in this country was by my colleague Dr. Wilks, in the 'Guy's Hosp. Rep.,' 1847, page 163. The disease is acute in every sense. It may involve a part only, or, the whole of the upper or lower jaw, both seeming to be equally liable to the affection; but in the majority of cases, the teeth of the affected bone are more or less diseased or deficient. It is a rare thing to find the disease in subjects who have sound teeth, or in those who have a cómplete set. Some openings down to the bone either through carious or deficient teeth, appear to be necessary to enable the phosphorus fumes to act upon the bone. Dr. J. Ward, of New York, records a case in which the whole bone died and was restored.

The disease begins for the most part by a general aching of the teeth, followed by rapid

suppuration and necrosis of the affected bone. The constitutional are usually as seve
the local symptoms.

Necrosis may also take place independently of any of the causes already allude
and may follow as a result of fracture, but its true cause is generally difficult to asce
It is found in both upper and lower jaws. An analysis of fifty consecutive cases s
that nineteen were in the upper, twenty-nine in the lower, and two in both, thus c
verting the assertion of Stanley, which has be
peated by others, that necrosis of the upper j
rare. It may show itself at any period of li
have seen it in an infant a fortnight old, altho
is more common in the young and middle-age
in the aged. It may attack any portion of the
and even the condyloid processes of the lower ja
die and be removed, leaving a movable jaw
spontaneous formation of a new joint. The ch
8, from whom I removed the bone here show
214), could move the jaw as well as if the
had never been destroyed, and, in 'Guy's Hos
for 1869, I recorded another similar case.

FIG. 214.



Portion of lower jaw removed for necrosis from a child æt. 8, the movements of the jaw subsequently being perfectly regained.

Necrosis of a bone is always preceded by
toms of inflammation, such as swelling and pain, followed rapidly by suppuration,
formation of sinuses leading down to the bone, which may be felt by a probe. A
sinus below the jaw or in the neighborhood may be due to the presence of a d
tooth.

TREATMENT.—When dead bone can be detected, either in the upper or low
there is only one form of practice which ought to be entertained, and that is remo
should be removed, too, with as little disturbance as possible to the soft parts, o
new bone-forming tissues, such as the periosteum, and by the mouth. When thi
practice is impossible or impolitic from any cause, the surgeon should take every c
his external incisions are made where afterwards they will be little seen.

In necrosis of the *upper* jaw, the bone can nearly always be removed by m
incisions made *beneath* the cheek. An incision *through* the cheek never seems ne
In necrosis of the *lower* jaw, when incisions through the integument are demand
should be made below its lower border. When the dead bone is fixed, or rathe
it has been thrown off from its attachments and before a new casing of bone h
formed, all operative interference must be condemned, particularly in the lower
there seems little room to doubt that the muscles, acting upon the new bone befor
become consolidated, may alter its shape and produce deformity. Under these
stances, the surgeon should content himself with seeing that all pent-up pus has fr
by means of incisions through the gums, also that the patient's mouth is kept as
possible by frequent washing, and that his general condition is maintained by n
tonic medicine and nutritious diet. When the necrosis is confined to the alv
which the temporary teeth are situated, great care should be taken that the parts
are not disturbed, and that the permanent teeth are not interfered with. Eve
exposed these permanent teeth need not of necessity be removed. In young
where much loss of bone has taken place, it seems desirable to have some artificial
tute, in order to prevent the occurrence of such an overgrowth of the opposing
took place in the cases already referred to. Where the antrum is exposed by exf
much may be done by the dentist to fill in the gap. A few years ago, Mr. Sal
skilfully adapted a plate with teeth to the upper jaw of a woman in whom the
wall of the antrum, with part of the alveolar process, had exfoliated. At times
fistulous opening takes place externally; thus, in 1864, I was called on to treat a
æt. 34, who nine years previously had had extensive necrosis of the upper jaw, a
consequence, a fistulous opening the size of a sixpence was left below the right ey
municating directly with the antrum. The soft parts were firmly connected
margins, and the lower lid drawn down. I raised the integument from the bone,
free subcutaneous incisions, pared the edges of the flaps, and brought them toget
the opening in the bone. Good union followed, and the deformity was removed.

TUMORS OF THE JAWS.

Some of the most remarkable tumors of these bones are due to hypertrophy or hyperostosis—the lower jaw with other bones of the face and head being generally involved. Mr. Howship's well-known case of disease of the upper jaw, which is noticed elsewhere, is a case in point; so is that of Mr. Bickersteth's, which was exhibited at the Pathological Society in 1866, and which he described with all minuteness in the 'Transactions' of the year. The disease is usually symmetrical, showing itself as a uniform enlargement of the bones involved—the upper jaws projecting as two large globular masses.

Cystic disease of the antrum.—This is a special affection and often connected with irregular dentition; though how often has not yet been determined.

Suppuration of the cavity is often due, doubtless, to an extension of inflammation from the teeth, and may arise from a blow or some other cause. It is known by severe local pain, extending over the face and forehead, local swelling, and extreme tenderness, the constitutional symptoms being often very severe. When pus has formed there may be rigors, and the abscess may burst either into the nose or into the mouth beneath the cheek—the antrum, under these circumstances, becoming much distended. In rare cases it may make its way through the cheek, and in one where this occurred, an opening into the antrum the size of a fourpenny piece was subsequently found, on making an incision down in the bone beneath the cheek. In neglected instances, the floor of the orbit may be displaced and vision interfered with or even destroyed. (*Vide* Salter, 'Med.-Chir. Trans.,' 1863.)

TREATMENT.—When suppuration has been made out, the antrum should be opened, and if its anterior wall be expanded, an opening may also be made into it without fear at the most projecting point with a trocar or other sharp instrument. The relief given by these means is very signal. In one case of a lady that came under my care some years ago, it was instantaneous and permanent. When diseased teeth are present in the bone, they should all be tested by a sharp blow, and the most tender removed. A jet of ether spray on each tooth will prove an admirable test, the cold searching out the slightest disease. It is never advisable to remove sound teeth unless some evidence exists of their alveoli being diseased. In all these cases the cavity must be kept clean by syringing. A chronic abscess in the antrum may be so insidious in its formation as to induce the surgeon to believe that a tumor exists. Liston gives an instance in his 'Practical Surgery' of such an error, in which removal of the jaw was attempted. In all tumors of the upper jaw, the probability of the presence of a large cyst should never be forgotten.

Hydrops antri is now a well-recognized affection, and is characterized by a gradual, painless expansion of the bone, rarely producing other symptoms than those due to mechanical pressure. It encroaches on the nose, and causes obstruction; on the orbit, and presses on the globe; on the mouth, and produces bulging of the palate; and, on the cheek, so as to cause deformity; indeed, it is often because of this, that the patient is induced to seek advice. When the expansion is great, the shell of bone may become so thin as to crackle like parchment under pressure. This sensation may be yielded by pressure upon its external or palatal surfaces. M. Giraldès, in 1853 (Montyon prize), was the first to describe these cysts with clearness, although Mr. W. Adams had previously recognized them. (*Vide* 'St. Thomas's Hospital Museum Catalogue.') The old surgeons looked upon this affection as the result of obstruction to the aperture between the nostril and antrum, the dilatation of the bone being due to retained mucus, but this is now known to be an error. All recent pathology tends to indicate, that it is a cystic disease of the mucous lining of the antrum, the affection showing itself as a single cyst, or, as a cystic degeneration of this tissue. Giraldès regards these cysts as dilatations of the glandular follicles of the mucous membrane. The fluid contents of these cysts are always viscid, occasionally clear, but mostly blood-stained, sometimes purulent, containing cholesterine, but never pure mucus. I have recently, however, had a case in a boy æt. 16, with Mr. R. Phillips, of Leinster Square, where the fluid was serous and blood-stained in a high degree.

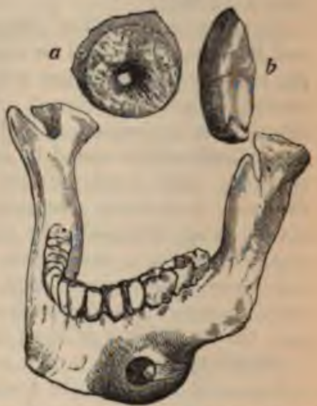
Dentigerous cysts are, clinically, closely allied to those just described; pathologically they may differ; but there can be no doubt that the cysts are connected with the teeth, which are in some cases fully developed, and in others imperfectly so. They are found in both upper and lower jaws. Heath, in his excellent 'Essay on the Jaws,' 1868, informs us that cysts of small size, in connection with the fangs of permanent teeth, are quently found on extracting the latter, but give rise to no symptoms demanding sur- l interference. Occasionally growing to a large size they produce absorption of the [illegible] rise to a prominent swelling. The disease is generally slow [illegible] by its pressure the cyst may cause absorption of [illegible] and a deep excavation. Paget relates in his 'Sur- [illegible] the gums, and I have had under observation a woman [illegible] years, which when opened, discharged some watery [illegible] bony projection of the cheek, that was clearly the edge of [illegible] upper jaw, the bone above having become absorbed by the [illegible] a cup-like depression. She had had all her teeth [illegible] under the impression that the disease was due to [illegible]

[illegible] in both jaws, and are almost always connected with the [illegible] recorded in which the temporary were implicated. In [illegible] development and remain within the jaw, the tooth, acting [illegible] and causing the cystic affection I am now con- [illegible] Thus in a boy æt. 6, who came under my care some [illegible] of the jaw of three years' development existed. It [illegible] I made an opening into the anterior wall of [illegible] and, through this, an incisor tooth was seen with [illegible] The tooth was removed and a good recovery ensued. In

[illegible]

[illegible] size of tooth when removed.

FIG. 216.



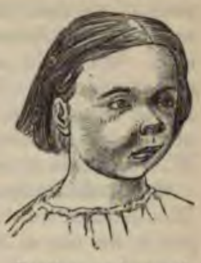
Canine tooth as seen in the case of Miss R—, in expanded lower jaw, with tooth (*b*) of its natural size. *a*. Bone removed by the trephine.

[illegible] in a girl, æt. 17, [illegible] her under obser- [illegible] in the right upper [illegible] deficient. I exposed [illegible] which was growing in [illegible] and inwards), a good re- [illegible] colleague Mr. Poland [illegible] a tooth with suc- [illegible] a tumor of three or [illegible] Miss R—, æt. 30, a patient of Mr. R. Moon's, of [illegible] and removed from it a canine tooth which was resting [illegible] Mr. Salter has collected many similar cases. It is [illegible] cysts like other cysts of the jaws, may simulate [illegible] lower jaw and expand the bone, this error is very [illegible] the jaws that have a smooth or cystic outline it is [illegible] puncture for the purpose of diagnosis. When the [illegible] expanded cavity, the diagnosis is simple.

[illegible] the cyst is the one essential point of practice to [illegible] the jaws, upper or lower, with the extraction of any [illegible] This can be done with a knife or a sharp pair of [illegible] been made by a trephine, drill, gouge, or pointed [illegible] the cyst, it is a good practice to plug the cavity [illegible] it is wise to take away a considerable portion of its [illegible] for cystic disease is rarely needed. Before, how- [illegible] malpractice was often perpetrated, as our different [illegible]

[illegible] occur. In Fig. 217 is illustrated a case, in [illegible] child, æt. 8, for a nearly solid myeloid tumor of the [illegible] tooth which was growing from the posterior part of the orbital plate of the bone; one or two cysts existed in the growth, enough to allow of its being called cystic. There was no possibility of making a diagnosis in this instance; such examples are very rare.

FIG. 217.



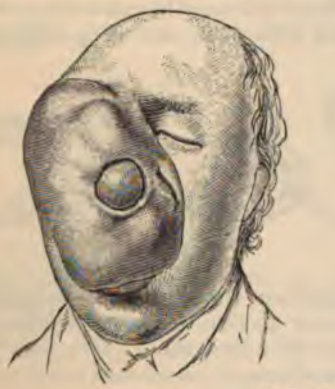
Dentigerous tumor of the jaw.

Tumors of the jaws.—These are of different kinds, simple and malignant, connected and unconnected with teeth. When in the antrum, their dental origin should be suspected, but in both upper and lower jaws, solid tumors of all kinds have been found with teeth as their centres.

Polypi of the antrum—as are those of the nose—are occasionally met with, and they show themselves mostly as projections into and through the nostril, the tumor making its way through the nasal wall of the antrum, and, at the same time, generally expanding its facial wall. I have seen four well-marked cases of this sort, and in two the whole mass was removed through the nostril, which was laid open, and turned back. In the third, the cheek was reflected outwards at the same time, and a large opening made into the antrum allowing the surgeon to scoop out the growth. Two of these cases occurred in the practice of Mr. Cock, and two in my own.

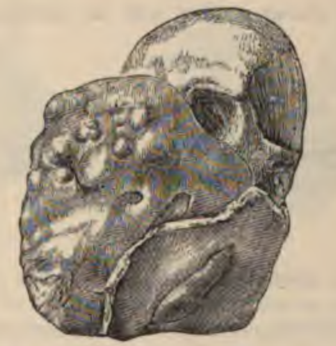
Tumors of the upper jaw.—Weber, quoted by Heath, informs us, that in an analysis of 307 cases of tumors of the upper jaw, more than one-third of the whole number may be set down as sarcomatous simple tumors, one-third as osseous, and less than one-third cancerous, the myeloid being included in one of these groups. They may grow also from any part of the bone or periosteum. When they originate in the antrum they expand its cavity, as is the case in the cystic disease, and cause a bulging of one or more of its walls. When they spring from a surface or plate, the tumor will project from it, leaving the other surface unaffected. The fibrous in all its forms and the osseous are usually of slow growth. They are often painless, and trouble only from their size. The fibro-plastic, myeloid, and cancerous are of more rapid growth. The fibrous or fibro-plastic are usually periosteal growths, the osseous, myeloid, and cancerous endosteal. The cartilaginous are very variable in their progress, now very slow and then rapid. They are chiefly of the mixed kind, fibre tissue largely predominating in tumors of slow formation. They frequently involve many bones. Sir J. Paget ('Surgical Path.') states, that in the only case on record of enchondroma of the upper jaw alone, the disease was removed by Mr. Morgan—late of Guy's—from a man æt. 24; the tumor was of the right maxilla and was of nine years' growth. The patient survived the operation seven years. Figs. 218 and 219 illustrate the case; the first being taken before Mr. Morgan's operation, and the second after the patient's death. Dr. Heyfelder, of Munich, says, however, that he found eight such cases out of 450 of disease of the upper jaw.

FIG. 218.



Before operation. Model, Guy's Hosp. Mus., 38^{10}.

FIG. 219.



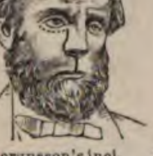
After death. Model, Guy's Hosp. Mus., 38^{19}.

Enchondroma of upper jaw.

TREATMENT.—All solid tumors of the upper jaw must be extirpated, but not more of the bone should be removed than is necessary. Sir W. Fergusson established this rule in practice, and it is one that all surgeons should strive to follow. Thus, when the disease springs and projects from the facial surface of the bone, the tumor, with the facial plate alone, requires excision. When the alveolar process is alone implicated, the other portions of the bone must not be touched. Where possible, the palate plate should be preserved, and it is bad surgery to interfere with the orbital plate without an absolute necessity. When the whole bone is involved in the disease, it must be removed, but such cases are exceptional. In many cases where the disease originates in the antrum, a partial removal of the bone will suffice, if the surgeon can at first only lay open the cavity and feel out the base of the growth. For perforating the antrum with a view to exploration Sir W. Fergusson recommends an ordinary carpenter's gimlet.

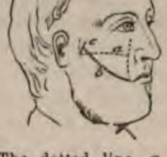
Operation for the removal of part or the whole of the upper jaw.—The incision now almost universally adopted for the removal of tumors from the upper jaw is the one of Sir W. Fergusson (Fig. 220); as by it all the necessary room is given to remove even the largest growth. The facial nerve and artery are divided where, by their size, they are of small consequence, and the scars are so placed as to become almost imperceptible. In tumors of *moderate* size, the incision should be carried through the median line of the lip into the nostril, when, by raising the nostril and retracting the cheek outwards, abundant room is obtained. When more room is required, the operator may extend his incision round the ala and up the side of the nose towards the inner canthus, and if this is still insufficient, a third incision may be made from the termination of the second along the lower border of the orbit.

Fig. 220.



Fergusson's incision for removal of upper jaw.

Fig. 221.



The dotted line, *a*, Gensoul's incision; *b*, Lizar's and Liston's.

These incisions are indicated in Fig. 220, which was taken from a man æt. 35, from whom I removed an osteo-chondroma, of twelve years' duration, involving the facial and palate plates of the superior maxilla. The dark line indicates the incision made; the dotted extra line that which may be required in exceptional instances. Fig. 221 illustrates Gensoul's and Liston's method.

In some cases, the ala of the nose alone may be turned up. I removed a fibrous tumor growing from the nasal process of the superior maxilla by this incision, and found ample room. The incision having been made, and integument reflected sufficiently to expose the tumor, all bleeding should be stopped by ligature or torsion. Assuming that the whole bone has to be removed, the incisor tooth of the affected side must be extracted, and the palate plate of the upper jaw with the alveolus divided with a fine saw (Fig. 222) introduced into the nostril. The malar process of the maxillary bone is then to be partially sawn through, as well as the nasal process of the superior maxilla, their complete section being made with bone forceps. The tumor should then be seized, the Lion forceps (Fig. 223) being employed, and the whole wrenched off, bone forceps and scissors being employed to complete any section that may be required. The infra-orbital nerve should be divided with scissors, and the soft palate left as little injured as possible. If any portions of the disease be left they can now be removed. All bleeding vessels are to be treated by ligature, torsion, actual cautery, or styptics, and the parts carefully brought together with interrupted sutures.

Fig. 222.

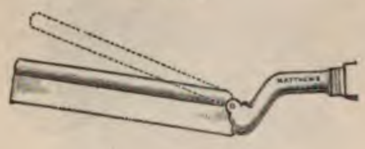
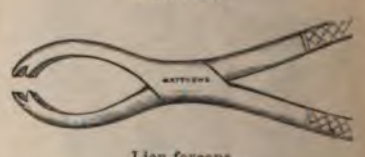


Fig. 223.



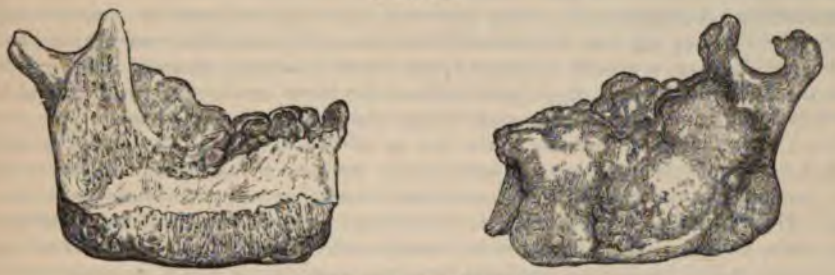
Lion forceps.

When the disease, says Heath, is of less amount and the orbital plate not involved, this should be preserved by carrying a saw horizontally *below* it; and if the palate be not involved, this may be advantageously kept intact by making a similar cut immediately *above* it. Sir W. Fergusson advises that the disease should be cleared out from the centre towards the circumference, so as not to remove healthy structures unnecessarily, and this may be readily accomplished by means of the many forms of curved bone forceps with which surgeons are now familiar, aided by the gouge.

In a case of myeloid disease of the upper jaw involving the whole of the hard palate, I peeled off all the soft parts from the bone, beginning at the alveolus, and, having removed the diseased bone, brought them up again in position and fixed them to the mucous membrane of the cheek where it had been separated from the bone. By this means I preserved the roof of the mouth from the first, and, what is more, eventually obtained an excellent new palate. The practice is probably worth attempting.

Tumors of the lower jaw grow to enormous dimensions, and pathologically are very similar to those of the upper. The fibrous in one of its forms is probably the most common, the periosteal tumor being more frequent than the endosteal. The latter may occupy the dental canal as illustrated by a case of Mr. Cock's (Guy's Hosp. Mus., 1091^{25}), in which the dental nerve passed through the tumor. The periosteal growth is often an epulis, and a good example of this form is represented in Fig. 209. But a more typical example of a true periosteal sarcoma which I removed in 1872, from a girl æt. 20, is illustrated in Fig. 224. The tumor was of three months' growth. It returned three months after removal, and destroyed life by suffocation, having grown to the size of the patient's head. Microscopically the tumor was a spindle-cell periosteal sarcoma. One of the largest fibro-cellular tumors of the bone on record occurred in Mr. Heath's practice, and is illustrated, with his permission, in Fig. 225. It was removed from a man æt. 32, and the disease was of eleven years' growth. It weighed 4 lb. 6 oz.; the man died from exhaustion on the sixth day.

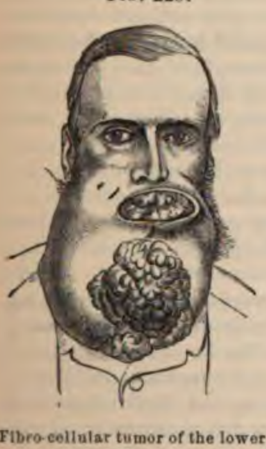
FIG. 224.



Periosteal sarcoma of lower jaw.

View of section. External aspect of tumor.

FIG. 225.



Fibro-cellular tumor of the lower jaw. Mr. Heath's case.

FIG. 226.

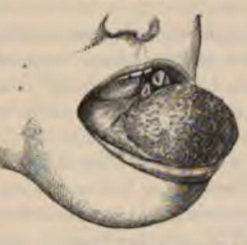
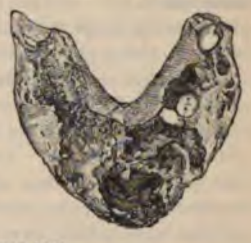


FIG. 227.



Fibro-cystic disease of the lower jaw.

Guy's Hosp. Mus., Drawing 4^{67}. Key's case, during life.

Guy's Hosp. Mus., 1090^{30}. Key's case. Tumor after removal.

Fibro-cystic tumors of the lower jaw are very common, and have the same clinical history and aspect as the cystic tumors to which attention has been already directed. The most beautiful example on record is that which was removed by the late Dr. Hutton of the Richmond Hospital, Dublin, and is illustrated in Heath's book; it was made up of cysts of nine years' growth, and in a young woman only 20. A yet more remarkable case was operated upon by Mr. Key in 1841, in a boy æt 13 (Figs. 226, 227). The tumor was of two years' growth and painless. Mr. Key removed the whole by sawing through the lower jaw just below the angle on each side, and a good recovery ensued.

Cartilaginous growths are uncommon, and occur in early life, and as already stated are periosteal and endosteal. A fine example of the latter can be seen in Prep. 1091^{15} and ^{16}, Guy's Hosp. Mus., which Mr. Key removed in 1846, from a woman æt. 29, in whom the disease had been coming on for nine years. In the preparation, the fibro-cartilaginous substance is seen to be placed between the plates of bone of the jaw, the teeth being in the middle of the new growth. The periosteal tumor grows to a large size.

Osseous tumors are sometimes the result of ossified enchondroma. There is in St. Thomas's Museum a specimen of this kind which was removed by Mr. Cline. Bone may, however, occur as an independent growth in the form of cancellated or ivory exostosis, which may sometimes grow to a large size or cause other troubles; hence, in March, 1877, I had to remove a portion of the lower jaw from a lady æt. 50, who had had an exostosis growing for twenty years from its inner surface at a point corresponding to the right bicuspid and canine teeth. The growth had not given rise to any trouble till the soft parts covering its apex had begun to ulcerate, when, from its roughened surface, the bone so irritated the floor of the mouth as to set up ulceration which was thought to be cancerous. I removed the exostosis with the bone and then reached the supposed cancer, which I isolated by needles passed through the base of the growth, and removed by means of the galvanic écraseur. A good result followed.

Cancerous tumors are usually endosteal, and numerous are the cases on record of the affection. They are met with in children and adults, and rarely are of the hard kind of cancer. They grow rapidly but soon break down, involving skin and all adjacent parts in the disease; indeed, any rapid growth about the lower or the upper jaw should be suspected as being cancerous. Almost all benign tumors are of slow growth.

Treatment.—Tumors of the lower jaw as of the upper are to treated by excision, which as a large operation is most successful. I have on eighteen occasions removed large portions of the jaws with but one death and that was from inflammation of the lungs. Heath says that Mr. Cusack removed large portions in seven cases with only one fatal result, and Dupuytren operated in twenty with only one death. Sir W. Fergusson also informs us that his success has been very great, and Syme and Liston's success is well known.

Small tumors of the jaw, and particularly of the alveolus, may be removed from the mouth with good cutting forceps. If more room be required to manipulate in the mouth, an incision may be made outwards or downwards at the angle. On several occasions I have obtained all the room I required by making a horizontal incision below the level of the jaw and a dissection of the soft parts off the bone.

Mr. Maunder has shown that large portions of the lower jaw the seat of tumor may be taken away without external incision after detaching periosteum by means of the raspatory.

When a large tumor has to be removed, it may readily be exposed by a curved incision carried along the posterior surface of the tumor from above the angle of the jaw to the median line turning the soft parts back. In doing this, the facial artery will be divided, and it should be at once secured at both ends by torsion; the knife, says Fergusson, being so lightly carried over the artery that it need not be divided till the flap is being raised, thus saving blood. The labial orifice rarely need be divided, and the incision should be stopped short of this margin. The tumor having been exposed, its surface must be well examined with the view of the removal of the growth by cutting away the external plate of the bone which covers it in, which can be done by means of the gouge and bone forceps. This step may be looked upon as wise under most circumstances, especially in doubtful cases, as a large number of tumors of the jaw, particularly the cysts, may be scooped out, and recovery ensue. If the tumor and jaw require excision a tooth must be extracted in front where the bone is to be divided and a small saw applied; the bone should then be grasped with the Lion forceps and drawn outwards—the surgeon carefully dividing all the soft parts that hold it in position on its inner surface, keeping the knife *close to the bone*. When the disease stops at the angle the saw and forceps are again to be applied and the tumor removed. Where disarticulation is required on account of the extension of the disease, the jaw must be forcibly depressed so as to bring the coronoid process within reach, and allow of the division of the insertion of the temporal muscle. The condyle may then be twisted out, the knife dividing cautiously such ligamentous fibres as are put on the stretch. Fergusson says that in doing this, he has found the condyle actually separated from the periosteum on its inner side, thus facilitating its removal, and in two cases of my own, I found this to occur in one after the division of the periosteum with the knife. When the tumor is so large as to be wedged in and prevent this mode of dislocation, the best plan is to reapply the saw and cut off the tumor as high as may be, and subsequently to remove the remaining portion of jaw. When the central portion of the lower jaw is removed, there is danger of the tongue falling back, and causing suffocation; to prevent this a ligature may be passed through the tip of the tongue and held during the operation, and on the completion of the operation it should be fastened to the wound. The ligature should be removed on the second or third day.

After the operation, all arterial bleeding should be stopped, a stream of cold water over the parts arresting any oozing, while the edges of the wound are to be brought together by interrupted sutures. Convalescence is generally rapid and recovery complete; the deformity following being so slight as not to be observed in many cases, the interval being filled with dense fibre tissue. Bone is never reproduced, but the tissues soon become firm enough to bear the support of artificial teeth.

The half-sitting position is probably the best in all these operations on the jaws; and chloroform may be given without fear. For more details connected with this subject the student may refer to Heath's admirable 'Monograph on the Jaws;' Fergusson's 'Surgery;' Liston's paper, 'Med.-Chir. Trans.,' vol. xx, and his 'Pract. Surgery.'

Disease of the temporo-maxillary articulation is rarely met with, more rarely indeed than disease of any joint in the body. I have seen only two examples of it, one in a woman, æt. 24, who had had it for nine years, suppuration having existed for six; several sinuses leading down to the joint were present, and the jaw was nearly fixed; dead bone appeared to be present; the patient refused to have any surgical interference. The second case was a girl æt. 18, in whom both sides of the lower jaw were completely anchylosed. In Guy's Hosp. Museum there is also a splendid specimen, No. 1070, of complete synostosis of the articulation.

The cases already quoted of necrosis of the condyloid process of the lower jaw, and recovery with a sound joint, may here be referred to.

Closure of the jaws may be caused by some spasmodic condition of the muscles of the jaw secondary to disease of the teeth, or the cutting of the wisdom teeth. In the latter the mouth must be forced open under chloroform, by means of the screw gag or wedges, and the tooth removed, or, what is better, room made for it to come forward by the extraction of a neighboring molar. It may likewise be caused as indicated above by anchylosis, or by the contraction of cicatrices either within or without the mouth. In February, 1878, I operated upon a woman, æt. 43, who for thirty-seven years had had her jaws locked from adhesions between the cheeks and gums. She had lived on liquid food for the whole of this period. I divided the cicacrices and opened the jaws with a promise of good recovery. The condition had followed scarlet fever. Dr. S. D. Gross, in his 'System of Surgery,' informs us that the latter causes are the most common, and he attributes the majority to the evil practice of giving calomel to salivation. In rarer cases the immobility is occasioned by an osseous bridge extending from the lower jaw to the temporal bone, this condition being generally associated with chronic articular arthritis. "However induced," writes Gross, "the effect is not only inconvenient, seriously interfering with mastication and articulation, but it is often followed, especially if it occur early in life, by a stunted development of the jaw, exhibiting itself in marked shortening of the chin, and in an oblique direction of the front teeth."

TREATMENT.—Where the cause is in the joint and cannot be removed, as can dead bone, the surgeon may attempt to break up the adhesions by forcibly opening the mouth under chloroform, or divide the bone below the joint. When due to cicatrices and nodular plastic matter, little good has ever been derived from their division although in the case previously alluded to the prospects of a good result are satisfactory. Esmarch, of Kiel, in a paper 'On the Treatment of Closure of the Jaws from Cicatrices,' 1860, has, however, described an operation for the formation of a new joint in these cases, such operation consisting in a removal of a piece of the lower jaw. The Messrs. Henry, C. Heath, Mac Cormac, Mason, Lawson, and Annandale in this country have practised Esmarch's operation, and the success has been enough to indicate its great value. It must be mentioned that about the same year Rizzoli, of Bologna, performed a somewhat similar operation to Esmarch's, dividing the jaw but not removing any portion of it.

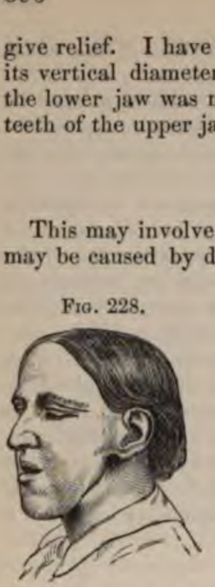
Operation.—This may readily be done by making an incision along the lower border of the jaw, in front of the masseter, and raising the integument, completing the operation by removing a wedge of bone, measuring about an inch above and a half below, with a hand or chain saw. Where only one side of the jaw is affected, it is without doubt the best operation that can be performed, the patients recovering their masticatory power in two or three weeks.

Deformities of the jaws are sometimes seen as a consequence of some disease of the tongue such as hypertrophy, the mechanical pressure of tumors during its growth, the evil influence of cicatrices more particularly about the neck and mouth, and various other causes. For these surgery may often do much, but when this fails, the dentist can often give relief. I have seen the upper jaw in two cases of torticollis nearly one inch less in its vertical diameter than the opposite bone, and I have already alluded to a case where the lower jaw was nearly an inch higher than natural, to make up for a deficiency in the teeth of the upper jaw and which had existed from childhood.

DISLOCATION OF THE JAW.

This may involve one or both condyles, two out of every three cases being bilateral. It may be caused by direct violence on the jaw, but more frequently by yawning. Sir A. Cooper tells of a case in a child, where it was produced by the forcible introduction of an apple into the mouth, and dentists know of its being produced even by the extraction of a tooth.

FIG. 228.



Dislocation of lower jaw. Couper's case. 'Lond. Hosp. Rep.,' 1864.

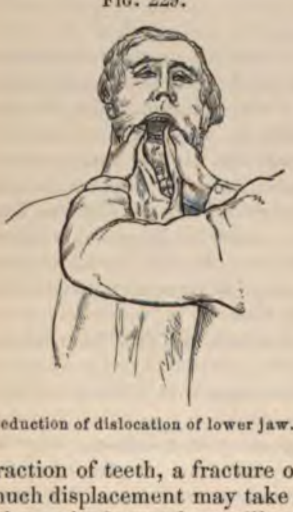
In the *double* dislocation, the mouth is widely open, the jaw fixed and projecting, the lips separated, and, as a consequence, speech is very difficult. Deglutition is much interfered with, and the saliva flows from the open mouth. In front of the ear, a marked hollow will be perceptible, and *above* the zygoma, in the temporal fossa, an undue prominence (Fig. 228). Adams, of Dublin ('Dub. Quart. Journ. Med. Science,' vol. i), first noticed these symptoms, and Dr. R. W. Smith ('Fractures,' 1854) believes them to be caused by the "displacement and stretching of the fibres of the temporal muscle on the upper surface of the condyle."

In the *single* dislocation, the chin is oblique, but usually directed towards the *sound* side instead of towards the *injured* side, as in fracture of the neck of the bone. In exceptional cases, however, this is not to be observed. The other symptoms are similar to those of double dislocation, the hollow in front of the ear being the most characteristic.

Congenital dislocations have been described by Smith, Guerin, Langenbeck, and Canton. Sir A. Cooper has also drawn attention to *subluxation*, in which he assumed that the condyle of the jaw slipped in front of the interarticular fibro-cartilage. It is caused and characterized by the same conditions as those of dislocation, and it is probably a partial dislocation forwards.

TREATMENT.—Partial dislocations or those described as subluxations, are usually reduced by the patients themselves, by some little lateral movement of the jaw, or, by gentle pressure upon the chin. Cases of complete dislocation have likewise been similarly reduced; but more frequently, the surgeon's aid is demanded. The patient should be placed in a chair with his head supported, while the surgeon stands in front. The operator, having well protected his thumbs with a towel or lint, may then introduce them into the mouth, and with the thumbs upon the last molar teeth he should firmly grasp the jaw. Pressure should then be made upon the teeth downwards and backwards so as to depress the condyles from their false position, at the next moment elevating the chin with the outer fingers. By these means reduction is readily effected (Fig. 229). Some surgeons prefer using a piece of wood or the handle of a fork to depress the jaws. When strong leverage is required, as in old cases, Stromeyer's forceps may be employed. It is well to reduce both sides together; and old standing dislocations may be thus reduced. Mr. Morley reduced one after thirty-five days, Spät after fifty-eight; Demarquay after eighty-three, and Donavan one after ninety-eight. (Heath.)

FIG. 229.



Reduction of dislocation of lower jaw.

FRACTURES OF THE JAW.

When the *upper jaw* is broken it is generally from direct violence, and when the "key" was employed for the extraction of teeth, a fracture of the alveolus was frequently the result. In severe injuries, much displacement may take place, and copious hemorrhage follows. Cases are on record where the internal maxillary artery was ruptured and a fatal result ensued. The infraorbital nerve or its branches are occasionally injured when some loss of sensation in the cheek will be produced. I have known emphysema of the cheek or orbit to follow such an injury, and have seen sub-conjunctival hemorrhage indicate it. One of the worst examples of fracture of the upper jaw I have seen, occurred in a man, æt. 30, from a fall from a height. Both upper jaws were completely detached from the skull and could be moved about in any direction, yet a good recovery ensued. I saw a second in an asylum and it was caused by the blow of a lunatic's fist. In this case the whole of the alveolar process of the right upper jaw was broken off, and the lower fractured in two places.

TREATMENT.—Where *no* displacement has taken place, little treatment is required; the parts should be left alone as natural processes will effect a cure. When *displacement* exists and can be remedied by manipulation, such means should be applied, some slight retentive bandage with or without a pad being employed to keep the parts in position. When the palate plate is much interfered with and displaced, the dentist's aid may be called into requisition, a gold plate well adapted to the parts tending to keep the fragments together; *vide* Salter, 'Lancet,' 1860. Hemorrhage, as a rule, can be arrested by the application of ice or styptics. When the soft parts are injured and bleeding takes place from them, the vessel should be secured. When the bone is comminuted, there is no need for the removal of fragments; Malgaigne laid this down as a law, and all surgeons now follow it, though Hamilton asserts, that owing to the extreme vascularity of the bones composing the upper jaw, the fragments have been found to unite, after the most severe gunshot injuries. In rare cases of separation of the maxillæ, says Heath, a spring passing behind the head and causing pressure upon the maxillæ, after the manner of Hainsby's harelip apparatus, might be advantageously employed.

Fractures of the lower jaw like those of the upper are, as a rule, the result of direct violence, and, when produced by gunshot injuries, are, at times, most severe. They are almost always compound, that is, towards the mouth, the gum tissues readily giving way. The body of the bone is more frequently broken than any other part, although the ramus and the neck of the jaw may be fractured. The line of fracture is generally oblique and very commonly near the canine tooth. Double fractures are very common, eleven out of twenty-four cases recorded by Hamilton being of this nature. Comminuted fractures are more rare. A case came under the care of Mr. Poland, at Guy's, in which the jaw was broken in five places by the kick of a horse. The symptoms of fracture are generally very clear, crepitus being often felt by the patient in attempting to move the jaw, and readily made out by the surgeon. The irregularity of the teeth is also a very characteristic symptom, and the care of the patient to hold the parts in position conjoined with his inability to speak is a typical sign. When any doubt exists as to the presence of a fracture the mobility of the broken bones will disperse it. Considerable displacement sometimes complicates the case, the position and the line of fracture determining this point; an oblique fracture near the insertion of a large muscle, as the masseter, necessarily showing a tendency to override. In double fracture of the body of the bone, this displacement is usually very marked, the muscles connecting the lower jaw with the hyoid bone drawing the lower portion down. In some this displacement cannot be completely remedied.

Fractures of the neck of the jaw are always the result of direct violence, and are not very readily made out; pain aggravated by any attempt to move the jaw being a constant symptom, and so also is crepitus perceivable by the patient. "The condyle," says Heath, "is drawn inwards and forwards by the pterygoideus externus, as can be ascertained by passing the finger into the mouth, and the jawbone is apt to become slightly displaced, so that the chin is turned towards the affected side and not from it, as is the case in dislocation." I have had under my care a man æt. 35, with a fracture of both sides of the jaw, just below the condyles, and with fracture of the symphysis, produced by a severe blow upon the jaw below the chin; and, from the displacement that followed the house surgeon thought it was a case of double dislocation; but on attempting to reduce it, it went in without the characteristic snap of dislocation. Ostitis and necrosis of the whole bone below the necks followed; yet a new jaw formed and the man recovered with good movement of the bone.

Fracture of the coronoid process is very rare; and Sanson says that such a fracture never unites.

TREATMENT.—When the bones can be brought into apposition, the treatment may be described as simple; and where difficulties are met with in reducing the fracture, the treatment is most difficult and uncertain. In an ordinary case of fracture of the jaw, where no displacement, or very little exists, the common four-tailed bandage, a yard long, with a slit in the chin piece of about four inches, made and applied as

Fig. 230.

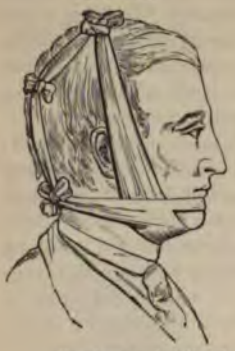
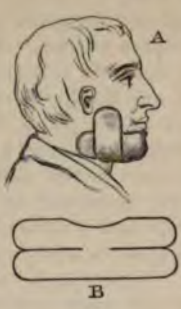


Fig. 231.



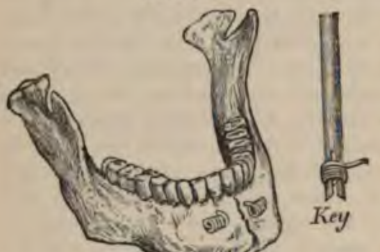
Bandage and splint for fracture of lower jaw.

illustrated in Fig. 230, is all that is necessary for *temporary* purposes, but for *permanent* treatment, in the few cases in which no displacement exists, it is well to mould on a splint of gutta percha, made according to the shape given in the accompanying illustration (Fig. 231, B), and applied as seen at A. When healthy teeth are present at the line of fracture they may be fastened together with wire, after the method of Hammond's splint (Fig. 235).

When difficulties are felt in the adjustment, as in double fracture, where the chin is much drawn down, a good pad may be firmly tied under the chin, or, a block of wood adjusted. In one case, I fixed a plaster cast, holding the jaw well in position by means of a piece of linen during the setting of the plaster. But in these cases, the surgeon's ingenuity is often taxed to the utmost to meet the wants of the individual case.

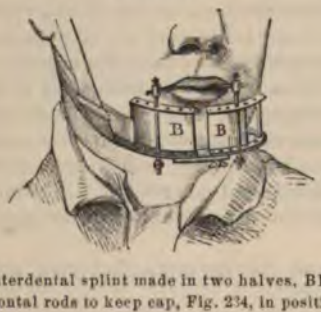
Some surgeons have suggested that the bones should be fastened together by sutures when all other means fail, and Mr. Hugh Owen Thomas, of Liverpool, has published cases to illustrate the practice. He applies the wire ligature after the fashion illustrated in Fig. 232, using a 1-24th inch silver wire, and fixing it with a key (Fig. 232). ('Lancet,' 1867, and pamphlet, 1875.) In the case of comminuted fracture already alluded to, two or three wire sutures were applied with the best results. Others advise the use of wedges of cork so adjusted between the teeth as to maintain the jaw in its right line. Hamilton speaks highly of gutta percha moulded to the teeth and gums within the mouth, and Tomes has invented a silver cap to fit the teeth for some distance, on each side of the fracture. Barrett carries out the same idea in vulcanite. Berkeley Hill's modification of Lonsdale's apparatus is serviceable, and Moon's splint, as made for him by Millikin, is also excellent. It has the advantages of all the other interdental splints already enumerated, is readily adapted to a jaw of any size, and, being introduced separately, is easily applied and can be as readily removed when desired, without shifting the cap which fits the teeth on either side of the fracture. Moon's splint therefore seems to be the best interdental one we possess, and it should be used when simpler forms are inapplicable (Fig. 233).

Fig. 232.



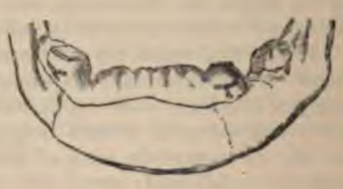
Thomas's mode of adjusting fractures of the lower jaw with wire and key.

Fig. 233.



Moon's interdental splint made in two halves, BB, with horizontal rods to keep cap, Fig. 234, in position.

Fig. 234.



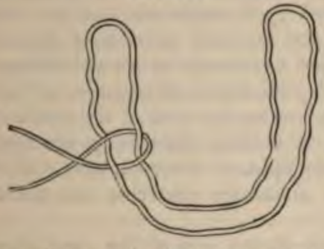
Metal cap fitted over fractured jaw. Represented as wired on for a time, after the withdrawal of external splint.

Among these simpler forms, I must class "Hammond's," which I had brought under my notice in 1874, by Mr. Moon. It is a very simple and valuable splint for the general treatment of fractures of the jaw and has answered admirably in all the cases to which I have had it applied.

The following description of the apparatus and its application is given in Mr. Hammond's own words:

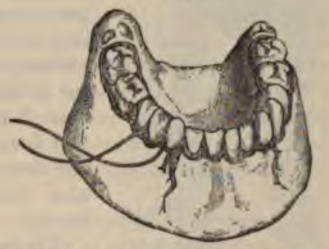
"I first place the patient in as convenient a position as circumstances will permit, then direct him to rinse the mouth with alcohol and water largely diluted, which not only cleanses the mouth but removes the fetor from the breath. I next bring (temporarily) the broken ends into approximation by passing a silk thread between and around the two teeth on each side of the fracture, and then secure by tying in front. Then with a suitable tray and very soft wax I take an impression of the teeth, to which, after its having been cast in plaster of Paris, I adjust a frame of iron wire (Fig. 235), which can be done with a pair of small curved pliers. When all is ready I slip the frame over the teeth in the mouth (Fig. 236), and while it is held in position by an assistant, proceed to tie by passing small lengths of thin iron binding wire after the manner shown in Fig. 235, twisting them in front, until each ligature is nearly tight, turning the ends on one side until they are secured. Next, with the aid of an assistant I twist the wires quite tight, working alternately each side of the mouth, so as to exert an equal pressure, and thus bring the bone into a natural position, also taking care not to overtwist or break them. I then cut off the ends and turn them in between the teeth. Now the jaw will be found comparatively firm, so solid, indeed, that the patient can bite steadily on it without pain. All that now remains to be done is to secure the jaw perfect rest by the four-tailed bandage." ('Monthly Review of Dental Surgery,' May, 1873.)

FIG. 235.



Hammond's wire splint for fracture of the jaw.

FIG. 236.



Hammond's wire splint applied to fractured jaw.

It is not absolutely necessary in all cases to take a cast of the broken jaw, although it is so in some, for the surgeon may mould a frame of iron wire upon another cast and adapt it to the special case without much difficulty.

The frame should be worn for six weeks.

DENTAL SURGERY.

BY MR. HENRY MOON.

GENERAL REMARKS ON DENTAL SURGERY.

Dental Surgery, in its manipulative details, must necessarily, for the most part, be left to those who make its practice a specialty, but some acquaintance with affections of the teeth, and with the principles on which they are treated, is required by every one who is engaged in the practice of medicine or surgery; for without such knowledge he will be unable to advise his patients on the preservation of their teeth (a subject of importance as regards their general health), or save them from the sometimes serious local complications which may attend tooth disease. Nor will he be able to diagnose the true nature of certain tumors and cysts of the jaws, or to attach the proper importance to the teeth as the possible cause of neuralgia of the head and face, and of more remote nervous affections.

In the following pages only a sketch of this branch of surgery is aimed at, and the reader is referred for details to the excellent 'Dental Surgery' by the Messrs. Tomes, and to the interesting pages of Mr. Salter's work, 'Dental Pathology and Surgery.'

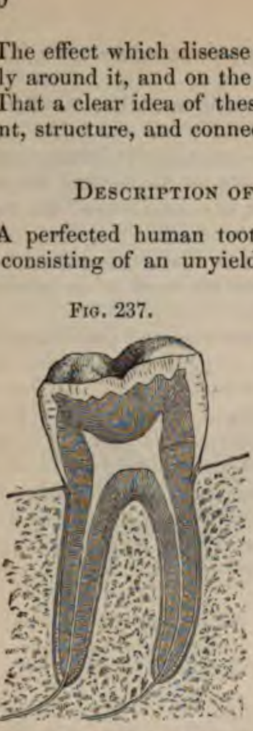
The various parts of our subject may, with advantage, be discussed in two main divisions. In the first section will be considered the defects in structure and abnormalities in form which may arise during a tooth's development, together with irregularities in its placement. In the second section will be considered the diseased conditions to which a fully formed tooth is liable, after it has assumed its destined position in the mouth.

The effect which disease or malposition of a tooth may have on the structures immediately around it, and on the general health, will also be noted.

That a clear idea of these subjects may be obtained, some points in a tooth's development, structure, and connection with surrounding parts must be borne in mind.

DESCRIPTION OF A TOOTH—ITS DEVELOPMENT AND CONNECTIONS.

FIG. 237.



Represents a vertical section through a lower molar tooth, showing its different component structures, and its connection with parts around.

A perfected human tooth (*see* accompanying illustration, Fig. 237) may be described as consisting of an unyielding case of dentine or ivory, inclosing a highly sensitive vascular pulp; the portion of this case that forms the crown of the tooth is protected by a covering of an extremely hard substance, "enamel," which becoming lessened in thickness as it extends down the sides of the crown, finally terminates at the neck of the tooth; the portion of the case that forms the root or roots is covered by "crusta petrosa,' or tooth bone, and is implanted in the alveolar portion of the jaw; the crusta petrosa is covered externally by a sensitive and vascular membrane, " the alveolo-dental membrane, or " periodontum;" this membrane invests the root of the tooth and lines the bony socket, and is besides intimately connected with the dentinal pulp at the apex of the root, and with the gum also where the latter structure encircles the neck of the tooth.

Through the foramen at the end of the root bloodvessels and nerves pass for the supply of the dentinal pulp, while other nerves derived from the same source (viz. the second division of the fifth in the case of the upper, and the third division in the case of the lower teeth) are distributed to the alveolo-dental membrane. The teeth are implanted in the alveolar process of the jaw, which is developed with them and is reabsorbed when they are lost.

Development.—The twenty developing temporary teeth, inclosed in their respective sacs, are contained in the jaw at the time of birth, as are also germs of the permanent molars and those of the anterior permanent teeth; these latter, receding from their position near the surface of the gums and becoming encapsuled, gradually pass down in the rear of the temporary teeth and remain embedded in the jaw, developing at leisure within their bony crypts until wanted to replace their more fragile predecessors. (*See* Fig. 239.)

The following is the normal process attending the eruption of one of the anterior permanent teeth. The roots of the antecedent temporary tooth having been absorbed, its crown is shed, and the new tooth then gradually uprises from the gum—the protrusion of its crown taking place simultaneously with the continued elongation and development of its root.

FIG. 238.

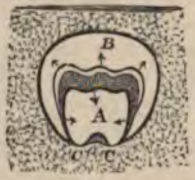


Diagram of developing lower molar tooth.

A. Dentinal pulp becoming centripetally encased by dentine.

B. Space occupied by enamel organ between centrifugally forming enamel and tooth sac. In this space fluid collects in the formation of a dentigerous cyst.

C. C. The base of dentinal pulp which remains attached and developing until the tooth is completed. By abnormal outgrowth at this point a radicular odontome would be formed.

The development of a permanent tooth thus occupies many years. Take, for examples, the first permanent molar and central incisor, the teeth which are the first developed of the permanent set. Their pulps commence to take form during fœtal life, their calcification commences by birth or in the first months of infancy. Their eruption takes place from the xth to the eighth year, and their root canals with their terminal foramina are not reduced their ultimate dimensions for two or more years later.

The three hard structures which enter into the composition of a tooth have distinct urces of origin. (*Vide* Diagram, No. 238.)

The enamel developed from the "enamel organ" of epithelial origin (which occupies he space B in the accompanying diagram) is formed *centrifugally* on the coronal dentine, nd through the obliteration of its formative organ becomes on the eruption of the tooth ncapable of further growth or nutritional change.

The dentine is developed from the "dentinal pulp" of vascular connective tissue (*vide* Diagram 238, A) by the immediate agency of a superficial layer of cells called odontoblasts.

The dentinal pulp or bulb, arising from the bottom of the tooth sac, and projecting into its interior, grows up beneath the enamel organ and progressively takes the destined form and dimensions of the dentine just prior to the formation of that structure; thus, the free end of the bulb, having taken the form of the cutting edge or masticatory surface of the future tooth, becomes capped by dentine, which forms on it from without inwards; and this crown cap being formed, the remainder of the tooth is developed by this gradual growth of the pulp at its attached surface or base (*see* Diagram 238, C, C) and at its subsequent encasement by dentine. In the fully developed tooth the pulp comes to occupy a comparatively constricted central chamber corresponding in form pretty accurately to the external contour of the tooth, and this chamber may be yet further diminished in size by a renewal of the centripetal growth of dentine.

Dentine, remaining as it does in connection with its formative organ through the medium of the tubuli of which it is mainly built up, is capable of a certain amount of increased solidification even at its periphery, and under certain conditions is endowed with most acute sensitiveness.

The crusta petrosa is formed on the gradually elongating root through the agency of the dental sac or capsule which surrounds the forming tooth crown, and ultimately comes to invest the root in the form of the fibro-vascular, "alveolo-dental membrane."[1]

The alveolar portion of the jaw grows up with and is moulded around the developing teeth, and upon the eruption of their crowns, affords the teeth firm implantation, by closely surrounding their roots.

Having thus far traced a tooth's development, we now pass to the consideration of the effects which follow departures from this normal process.

ODONTOMES.

Tumors which result from the abnormal and excessive development of the dental structures at any time during the tooth's formation have been grouped together by M. Broca under the name of Odontomes,[2] and classified by him as follows:—

I. **Odontomes embryoplastiques.**—Those which arise before the dental pulp has developed odontoblasts, and before the enamel organ has acquired special enamel-forming cells.

II. **Odontomes odontoplastiques.**—Those which arise after the special dentine and enamel-forming cells have been developed, but prior to the formation of the coronal cap of dentine.

III. **Odontomes coronaires.**—Those which arise while the crown is forming.

IV. **Odontomes radiculaires.**—Those which arise during the formation of the root.

These four designations, pointing respectively to the periods in the tooth's development at which the hypergenesis of the pulp has arisen, also indicate to a certain degree the structural formation of a tumor formed at either period; but in adopting these terms it must be understood that, in one sense, the embryoplastic and odontoplastic conditions are present consecutively during the whole period of dentification, and also that if the odontoblast layer of cells is destroyed at any point, true dentine will not there be formed, although the pulp may undergo calcification, resulting in a kind of osseous structure.

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[1] From the dental sac is also probably derived the membrane known as the "cuticula dentis," or "Nasmyth's membrane," which in an unworn tooth is found continued over the crown, and is regarded by C. Tomes as an undeveloped cemental layer.

[2] Exostosis of the root and "dentine excrescence" in the pulp chamber are called by Mr. Salter "secondary odontomes," and naturally come under that designation, as might also the outgrowth of the pulp which sometimes follows the exposure of that structure; but as these are affections of the fully developed tooth, they will be considered in the second division of our subject.

Embryoplastic odontomes.—Under this name M. Broca ranges encysted fibrous and fibro-plastic tumors of the jaw. As the dental germ at the time of their origin contains no special dentine and enamel-forming cells, distinctive dental structures would of necessity be absent from these growths, and such absence must of course leave their dental origin in doubt.

In one instance (mentioned by Tomes) M. Robin met with a tumor in the lower jaw of a child, æt. 2½ years; this tumor, apparently fibrous, was studded with papillæ, on which distinct dentine and enamel were found. Now, whatever doubt may arise as to the origin of the before-mentioned tumors, there can be no doubt as to the dental origin of this one, and it is probable that in it a longer existence would have been accompanied by further dentification. In another odontome, which occupied half of the lower jaw of a girl æt. 1 years and 9 months, M. Broca found the formation of dentine proceeding at numerous points, and the fusion of these secondary bulbs, coated as they were with enamel organs, would result in bringing about the structural conditions found in an odontoplastic odontome.

Odontoplastic odontomes, in outward form, may bear not the slightest resemblance to a tooth.

Structurally they consist of a more or less confused mass of dentine, enamel, and osseous structure; the dentine occurring in tracts, between which the enamel has dipped down. Enamel is also found capping nodular projections which occur on the surface.

The case met with by Dr. Forget and reported by him may be cited as an example. A man æt. 20 presented himself with disease of the lower law, from which he had suffered since he was five years old; on looking into the mouth a hard smooth tumor was seen occupying nearly the whole of the left side of the lower jaw. None of the teeth beyond the first bicuspid were present. On removal (by section of the containing bone) this tumor proved to be a hard, oval, tuberculated mass, the size of an egg, chiefly composed of dentine, with enamel investing the nodules and dipping into crevices. Between the tumor and the osseous crypt which it occupied, there was a thick fibro-cellular membrane. The forming second bicuspid tooth and the crown of a molar were found impacted in the jaw through the superposition of this mass.

The bulbs of one or more teeth, normal and supernumary, may enter into the formation of one of these tumors, and surrounding teeth in various stages of development may become inclosed by it.

In one instance reported and figured by Tomes, a large tumor, presenting the appearance of a malignant growth, occupied the incisive region of the upper jaw of a man aged 25, his four upper incisors not having appeared. A probe introduced into the tumor impinged on something hard, which proved to be sundry masses of tooth structure, best described as odontomes, together with some ill-formed teeth. These specimens, numbering in all fifteen, are in the Museum of the Odontological Society of London, and the case may, perhaps, be best described as one of disrupted odontoplastic odontome.

In a case reported by the late Mr. Harrison, an odontoplastic odontome occupying the space between the incisors and molar teeth, came away spontaneously.

In one or two reported cases the tooth bulb having produced an eccentric formation such as described, instead of an ordinary crown, has afterwards assumed normal limits and formed fairly shaped roots.

Coronary odontomes.—In these the main outline of the tooth is preserved, but an irregular outgrowth, more or less circumscribed, projects from the crown. This outgrowth, having arisen while the crown was in process of formation, consists of the coronal tooth structures, viz., enamel, dentine, and possibly inclosed pulp. If small and involving the neck of the tooth, an outgrowth of this nature may be at first mistaken for tartar.

Somewhat allied to these cases are those in which a tooth presents one or two supernumerary cusps or supernumerary teeth merged with it.

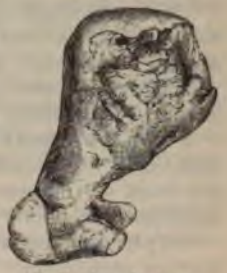
A small globular projection of enamel is also occasionally met with on the root of a tooth, and has been ranged among odontomes by Salter, who, finding that it caps a cone of dentine, calls it "a submerged tooth cusp." The crown of a simple supernumerary tooth has been found attached in the same position, and probably these cases have a like origin.

Radicular odontomes.—This form of tumor, which in several recorded cases has attained the size of a chestnut, is found attached to the neck and root of a fully-formed tooth by a more or less constricted base, and results from an irregular outgrowth from the dentinal pulp.

Structurally, radicular odontomes generally consist of osteo-dentine more or less covered-in by a layer of dentine, with a coating of cementum externally.

An odontome of this kind, embedded in front of the anterior margin of the ascending ramus of the lower jaw, and passing up behind the tuberosity of the superior maxilla, was recently removed by me at Guy's. This tumor (see Fig. 239) was attached to the lower wisdom tooth of a woman æt. 38. This patient had experienced no inconvenience from her mouth *up to the age of* 30, when great swelling over the ascending ramus occurred, accompanied by closure of the jaws and excruciating pain. These symptoms—*with intervals of complete cessation for two or three months at a time*—recurred until the odontome, which was gradually being extruded, was removed (very easily) by extracting the tooth to which it was attached.

FIG. 239.



Radicular odontome.

In the case which is figured and reported at page 386, Fig. 212, a symmetrical enlargement of the whole root occurred, producing a dilated hypertrophied tooth fang.

Odontoplastic and radicular odontomes are very rare, only a few cases of each in the human subject being recorded, but the recognition of the true nature of these tumors and of others which have a dental origin is of course of the highest importance, as it will avert an unnecessarily severe operation for their removal. In the case of tumors and cysts of the jaws the undue absence of any tooth will point to the probability of their dental origin, but the possibility of such origin would not be excluded if the normal number of teeth were present, as a supernumerary tooth may originate either an odontome or a dentigerous cyst.

A glance at the close packing of teeth in a child's jaw, as shown in Fig. 241, will show the strong probability of a dental origin for tumors and cysts of the jaws in young subjects, especially when it is remembered that each of the forty-eight teeth to be seen in such jaws at one time, is, or has been, the centre of developmental activity; the likelihood also that tumors may cause involvement or displacement of neighboring teeth will be readily realized.

Gemination, or the union of contiguous teeth, due to the fusion of their pulps, is met with occasionally in both the temporary and permanent sets. Normal teeth may be thus joined, or normal and supernumerary.

Dilaceration, or the abrupt change in the direction of the first and last formed portions of a tooth, sometimes occurs, and is due to a shifting of the forming tooth on its base.

Dentigerous cysts are cysts formed by the accumulation of fluid within the dental capsule at some period of the tooth's development, or around a fully-developed tooth which has not erupted. They may, therefore, advantageously be classified, like odontomes, according to the point to which the tooth's development has proceeded, when the change occurs which eventuates in their formation.

When fully developed, a dentigerous cyst usually consists of a thick membranous sac, covered in by a thin osseous shell, formed by the expansion of the bone of the jaw. In a case met with by Mr. Fearn one-half of the lower jaw was expanded by a cyst, which separated its external and internal plates. The cyst wall itself in some instances has been found calcified. The cyst at first usually contains a serous fluid, which may become purulent through the occurrence of inflammation.

The uncut tooth (temporary, permanent, or supernumerary) about which the cyst has expanded, may be represented by a small shapeless, calcified mass, if its formation was disturbed in the embryoplastic or earliest odontoplastic periods. This fact was well exemplified by the case of a girl aged 13, who was recently at Guy's under the care of Mr. Cooper Forster. Here two small irregular masses of dentine and enamel, the representatives of an absent canine and lateral incisor, were contained in two distinct cysts, which caused great protrusion of the anterior wall of the superior maxilla. The inclosed tooth may be attached firmly to the cyst wall, or may be found free within the cyst.

A dentigerous cyst, forming in the upper jaw, may expand into and cause distension of the antrum. Professsor Baum met with a case of immense dilatation of both antra, one containing a molar, the other a canine.

In some cases the tooth crown only, or the crown and part of the root, have been formed prior to the expansion of the capsule by serum, and these may be said to belong to the coronary and radicular periods. In other cases, again, the cyst develops around fully formed impacted teeth, which may be found inverted. In one instance mentioned by Tomes, no less than twenty-eight separate and adherent denticles (or small supernumerary teeth) were found in a cyst of the upper jaw, and are probably to be looked upon as the elements of teeth that were missing.

Although both odontomes and dentigerous cysts have their origin in early life, years may elapse before the irritation caused by the presence of the odontome, or the increasing disfigurement and pain resulting from the enlargement of the dentigerous cyst, may lead a patient to seek surgical aid.

Cysts developed on the root of erupted and fully formed teeth are not classed here as *dentigerous*, as they form only an appendage to the tooth. They will be referred to among the diseases of the teeth, but it may be here remarked that they sometimes attain to a large size, and may, like dentigerous cysts, expand into the antrum, and also that their contents under inflammation may become purulent.

Supplemental teeth (*i. e.* extra teeth exactly corresponding to a neighboring normal tooth) are occasionally developed in both temporary and permanent sets, usually in the front of the mouth. If they cause crowding or are placed before or behind their doubles, they should be extracted.

Supernumerary teeth (*i. e.* teeth differing in form from any of the normal series) are not unfrequently found in the upper incisive region and occasionally in other parts of the mouth. A pair of teeth somewhat resembling incisors, but of greater antero-posterior depth, and with a deep pit on their lingual aspect, are occasionally developed behind the permanent upper front teeth, and others more resembling small molars or bicuspids are also occasionally met with, but by far the commonest form that the crowns of supernumerary teeth present is that of a simple cone, or of a cone truncated and pitted on its summit, and these teeth have a characteristic straight terminal line to the enamel at their necks; they are, in fact, the most elementary form of tooth formation.

As a general rule, supernumerary teeth are to be extracted, and will always be found to have a single root, which may, however, be contorted and expanded.

Malformed teeth.—Abnormalities in the form of teeth may result from the dwarfing or excessive development of the different parts or lobes, of which they are architecturally built up, and in certain cases are of great value in the diagnosis of constitutional peculiarities and in throwing light on the condition of health present during a patient's early years, when the teeth were in process of formation.

Syphilitic teeth.—Mr. Jonathan Hutchinson first pointed out the association between congenital syphilis and a mis-shapement of the permanent teeth. This malformation is generally most strikingly apparent in the incisors, the upper centrals presenting the shape, diminution in size, and often the slight change in direction shown in Fig. 240A, instead of the normal condition represented in Fig. 240B. These dwarfed teeth present differences of form, but the most characteristic change in them is their lessened breadth at the cutting edge as compared with that of their necks, the vertical groove on their anterior face being often absent, and the notch on their cutting edge not being an absolutely constant feature, and being also subject to obliteration through wear. The lower incisors usually present a corresponding shape, and the other teeth may have their corners rounded off, and in the case of the canine be notched. The shape of the first permanent molars is almost invariably altered (a fact, I believe, not hitherto pointed out), the suppression of their angles giving them a dome-like form, their size being often reduced, and the enamel absent from their masticatory surfaces.[1]

FIG. 240A.

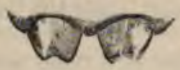
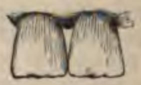


FIG. 240B.



The above-described malformation is essentially due to a change in form of the dental pulp prior to its dentification.

Some children, recently seen by me, present, together with great peculiarity of their eyes and a general weakness in the development of their dermal structures, the following peculiarities in their teeth:—The middle lobes are sharp, recurved, and excessively developed, while the lateral lobes are dwarfed. In these cases, however, the pointed form of tooth which results can be readily distinguished from the truncated cone-like form indicative of congenital syphilis, as the latter is due to a dwarfing of the central lobe and a leaning inwards of the lateral lobes.

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[1] The absence of enamel here mentioned may, however, be due to the administration of mercury, as the malformation typical of congenital syphilis may be seen well marked without any enamel defect in cases uncomplicated by mercurial treatment. The same remark may be applied to the discoloration that has been observed in syphilitic teeth.

The syphilitic tooth with its conical form is also by no means to be confused with the teeth which present a narrowness of their cutting-edge due to an absence of enamel from the first-formed portion of the crown, a condition often seen in the so-called honeycombed teeth now to be noticed.

The rocky or honeycombed condition of a tooth's crown results from an irregular and insufficient development of enamel, producing horizontal groovings or a pitting of its surface.

Mr. Hutchinson considers that the most frequent cause of this defect is the administration of mercury in infancy; and in many cases seen by me it appears traceable to the use of one of the most popular of teething powders, which contains calomel together with an opiate. It is not, however, certain that convulsions and other illnesses in childhood may not produce it.

The first permanent molars on their masticatory surface most often show the absence of enamel, while the incisors and canine are affected to an extent which depends on the amount of their development while the agency which arrests the enamel formation is in action; the later formed bicuspids, second molars, and wisdom teeth, often altogether escape.

The irregularly formed enamel may be structurally defective, as shown by its discoloration, and this may conduce to decay, as does also the pitting of the enamel if it extends through to the dentine. In other cases the diminished size of these teeth, which prevents their being crowded and exposes their sides to healthful friction, renders them less obnoxious to decay than might have been expected.

Imperfections in Structural Development.

At the present day the early decay and loss of teeth is very common, and is probably in part due to an insufficient supply of food containing the elements which go to build up the osseous structures,[1] malnutrition in early life, from whatever cause, leaving inevitably its mark on the exteriors of the teeth, which, once ill formed, have no power of recuperation.

Structural defects in enamel development.—Perfected enamel contains upwards of 95 per cent. of earthy matter, and consists of rods united together without intervening matrix, and placed at right angles to the surface of the dentine. Enamel, when well formed, is semi-transparent, but when defective from a want of homogeneousness in its structure it presents an opaque white, chalky appearance, and is then easily disintegrated. At the bottom of the natural sulci of otherwise well-formed teeth enamel is sometimes deficient in thickness and in soundness, and this favors the ingress of decay.

Structural defects in dentine formation.—Well-formed dentine is uniformly dense and ivory-like. It is built up of tubuli and intertubular substance, the tubuli serving to convey nutrition from the pulp to the periphery. Dentine is endowed with sensitiveness through nerves (probably too small for demonstration), which pass from the pulp to the surface and render the dentine immediately beneath the enamel especially sensitive.

Through imperfect development a (so-called) granular layer which is found on the surface of dentine in the root may be present on the surface of coronal dentine. The (so-called) globular condition of dentine is another developmental defect. When the enamel covering is lost, imperfect dentine softens rapidly under decay without becoming darkened, and is also apt to be exceedingly sensitive.

Cutting of the Teeth.

During the eruption of the temporary teeth, if there is disturbance of the general health traceable to dental irritation; and especially if there be the least sign of cerebral disturbance, there should be no hesitation in freely lancing the gum—tumid or tense—which covers the tooth that is presenting. In the case of a front tooth a straight incision should be made on to the front of its cutting edge; in the case of the molars a crucial incision should be made from corner to corner.

As a rule the permanent teeth erupt very easily, but an incision with a lancet may sometimes with advantage be had recourse to in cases where cerebral disturbance is easily excited, and it is often well to remove bodily the gum from above an erupting wisdom tooth when an antagonist tooth bites upon and irritates it.

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[1] In infancy and childhood plenty of good milk and the use of "*whole* flour meal" are to be recommended; it is to be borne in mind that until a child begins to take animal food, the above are the sources of supply of lime salts.

Irregularity of Position.

Irregularity of arrangement hardly ever occurs among the temporary teeth, but an undue prominence of the upper incisors, which sometimes is acquired, and a tendency to underhanging, from the over-development of the lower jaw as compared with the upper, should receive attention, in order that these conditions may not be perpetuated in the second set. The absence of the spacing of the temporary teeth, which should precede their shedding, will point to a likelihood of crowding among the coming permanent teeth, and demand watchfulness.

Irregularity of the permanent teeth often results from the want of timely extraction, and even oftener from the untimely extraction of temporary teeth. It therefore behooves the surgeon who may be called upon to extract teeth for young subjects to acquaint himself with the time of eruption of the different permanent teeth, and with the points of difference between temporary and permanent teeth.

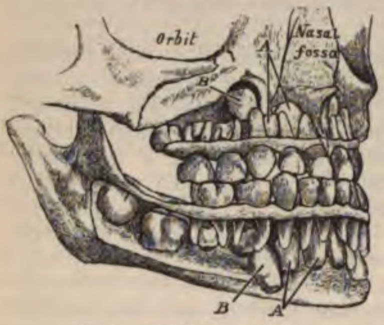
Well-developed adult jaws should consequently be thoroughly studied as a type, and compared with the jaws in childhood. It will be then seen that development has occurred longitudinally backwards for the accommodation of the permanent molars, while the part of the jaws that was occupied by the ten temporary teeth, having undergone additional development on its anterior surface, is in the adult occupied by the incisors, canines, and bicuspids. In order that these latter may have room for even arrangement, it is important that the anterior permanent molars (the six-year-old teeth) should *not* be allowed to take up a too forward position, which they will do if the temporary molars are prematurely lost from neglected decay. On this account, therefore, the timely stopping of the back temporary molars is a practice to be recommended.

The accompanying figure will show how easily irregularities may be brought about, as the retention of the root of a temporary tooth is enough to prevent the permanent tooth from taking up its proper position.

In judging of the amount of space that there will be for the accommodation of the coming teeth, it is to be remembered that the alveolar portion of the jaws grows up with and is moulded around the teeth it supports, and that there is a strong tendency for teeth to assume their proper position (the action of the tongue and lips conducing thereto), while the replacement of the temporary molars by bicuspids increases the space for the front teeth.

A very common form of irregularity results in otherwise well-developed jaws from the permanent upper incisors being erupted to the rear of their unshed predecessors. In such a case the prompt removal of the temporary tooth is demanded, for if, on the further elongation of the upper permanent incisor, its edge once passes behind the incisor of the lower jaw, at each closure of the mouth the evil is increased, and can then only be corrected by the use of a regulating plate. On the same score, lower incisors may sometimes be kept in the rear of the temporary teeth in order that they may be ready to wedge forward the upper incisors, and thus *secure the overlapping of the upper front teeth* which allows of their true incisive action while it spares them undue wearing away.

Fig. 241.



A. Permanent incisor teeth.
B. Permanent canine.

Drawing of jaws of child æt. 6. A and B point to permanent incisors and canines. The bicuspids are seen embraced by the roots of the temporary molars. The permanent molars, with the exception of the wisdom, are present.

In spite of the above precautionary measures at the time of the second dentition, cases of irregularity will occur from malformation and insufficient development of the jaws. Some of the slighter of these irregularities are amenable to surgical treatment—that is, a timely extraction will allow nature to set all straight—but if a tooth is taken out on one side of the mouth to relieve overcrowding, the preservation of symmetry will often demand the extraction of another on the opposite side. The patient's profile and the relative prominence of the upper and lower dental arches have to be considered in deciding whether permanent teeth should be extracted for regulating purposes, while the soundness of teeth, e direction taken by their roots, the firmness of their implantation, and their compartaive rability, are all points to be considered in deciding which tooth should be sacrificed for e benefit of the remainder.

Sometimes the first permanent molar may with advantage be taken out when the tenency to overcrowding is decided. If this tooth, which is particularly liable to decay, is ast hope of permanent preservation by stopping, its extraction in time allows the second olar to come forward and partly occupy its site, and the wisdom tooth to come well into lace, while it also enables the front teeth to spread, and thus escape undue lateral pressure nd consequent decay.

The one valid objection to the extraction of the first permanent molar, under the above ircumstances, occurs when the withdrawal of the prop which this tooth affords at the back f the mouth would cause the lower incisors to bite up unduly on to the necks of the uppers nd drive them forward.

Here it may be remarked that in all attempts to improve the regularity of the teeth the elative positions of the antagonist teeth in the other jaw must be taken into account.

So far only those cases have been considered that are capable of being benefited by imely extraction, but many cases require for their treatment the use of mechanical appliances. Among these appliances a lever for expanding the arch of the upper teeth (while it presses back the lower) and elastic bands are of great use; while in more advanced cases a regulating plate must be worn, the principle of its action being that it affords a fixed point from which continuous pressure or traction is kept up on the teeth to be moved.

The movement of teeth by mechanical means should be gradual, or absorption of bone will result without a compensatory development, and the teeth will be loosened. Twisted teeth can be turned on their axes. Instanding upper front teeth can be trained out, and will be retained in their new positions as soon as they are brought to overlap the lower teeth; prominent and projecting upper teeth can be gradually trained in, but will be required to be kept in place for some time by mechanical means to prevent their reverting to their original position. The lower lip passing behind prominent upper incisors increases the deformity which is usually associated with a contracted arch.

In regulating teeth much greater difficulty has to be overcome where contraction or malformation of the jaw causes the irregularity, than in those cases where there is simple misdirection of the teeth themselves.

In some cases complete underhanging of the jaw is present, *i.e.*, the upper teeth, back as well as front, are set within the arch of the lower teeth; this condition does not admit of much remedy when once firmly established, but may be prevented to a certain extent by timely extraction of lower teeth together with a training out of the upper. The earlier that irregularities receive attention the better, in order that the misplacement may not be increased, and also because the moving of teeth can only be safely effected in the young.

Canine and wisdom teeth, owing to the lateness of their eruption and the position they occupy during development, are peculiarly liable to be shut out from the dental arch. The canine being a durable tooth, should in some cases have room made for it by the extraction of one of the teeth that have closed in upon its site. The cutting of wisdom teeth is frequently attended with much trouble, and it may be remembered in the case of young subjects with small maxillæ, whose first or second molars are much decayed, that the timely extraction of either of these teeth may allow the wisdom tooth (if developed) to erupt easily and occupy a useful position. In the upper jaw, if the wisdom is forced to take an outward direction, and so cause irritation of the cheek, it should be extracted. In the lower jaw, where there is insufficient room for it between the second molar and the ascending ramus, its efforts to erupt often produce nerve irritation, chronic spasm of the masseter, the formation of pus between the crown of the tooth and the superjacent gum; it may also cause absorption of the root of the second molar and lay bare its pulp.

In all cases where the impaction of a lower wisdom tooth is a source of irritation, the impaction should be at once got rid of either by the extraction of the wisdom tooth or of the tooth in front. The operation required, as well as the serious results which may attend purulent inflammation about an impacted wisdom tooth, will receive notice later.

Teeth are sometimes erupted in strange positions; thus, Salter records a case of inversion and eruption of lateral incisors in the nares, and Tomes figures the case of a molar erupted in the median line of the palate, and another case in which the crown of a molar pierced the cheek at the angle of the jaw. In another case, figured by Tomes, the crown of a molar presented at the sigmoid notch, but remained impacted.

Impaction, or retention of a tooth within the maxillary bone often occurs without any ill results, but occasionally it is productive of severe mischief. Thus, in a case which occurred in the practice of Mr. Cartwright, Sen. (and which is reported at length by Mr. Salter), it was productive of severe neuralgia. In this case the presence of an impacted upper canine, which caused a prominence on the palate, gave rise for eight years to constantly recurring, most severe neuralgic pain, confined to a circumscribed spot on the left side of the vertex of the head. In other cases it may give rise to cystic enlargement or abscess, the latter, perhaps late in life, from the buried tooth becoming more superficial through absorption of the containing bone. The palate may be involved if a tooth is impacted within the palatine process of the superior maxilla, or an abscess may be formed below the tongue from impacted lower teeth.

The following case was reported by Mr. McCoy in the 'Lancet,' 1871: A boy, æt. 14, had a tumor of the antrum the size of an apricot, due to an impacted canine, the crown of which projected into the antrum, while the root was impacted in a socket in the nasal process; the antral cavity contained a little glairy fluid, but was chiefly filled by a gelatinous substance—apparently thickened mucous membrane.

Absence of Teeth.—A few cases are recorded of edentulous jaws. Wisdom and upper lateral incisors, the teeth most liable to variation in size and shape, are also the most liable to suppression. Occasionally other permanent teeth fail to make their appearance, in which case it may be right to leave their predecessors undisturbed, if they show no signs of loosening; temporary molars may in such cases serve for many years.

The tendency of particular teeth to take irregular positions, and the liability of others not to be developed, are facts that have to be borne in mind in connection with the probable dental origin of tumors and cysts of the jaws.

Before passing to the second division of our subject it may be useful to enumerate the morbid conditions which may be simulated by the tumors, cysts, &c., which originate from an unerupted tooth in the ways described in previous pages.

Odontomes may give rise to appearances such as may be presented by benign or malignant tumors, whether arising spontaneously or due to the impaction of a foreign body, such as root of tooth, splinter of bone, or a bullet.

Dentigerous cysts, when slowly forming and before they have thinned the inclosing bone to an extent which would allow of the characteristic sign of *craquement* on pressure, may be difficult to diagnose from solid tumors.

A dentigerous cyst may also produce the same symptoms as a cyst formed on the root of an erupted and diseased tooth, and when through inflammation its fluid contents become purulent it may, in like manner, resemble an alveolar abscess (*i. e.*, an abscess formed around the root of a diseased tooth), and, like it, will be apt to give rise to a fistulous opening.

Suppuration in the antrum, or Empyema, arises probably in two distinct ways. In the one case it is due to inflammation of the lining membrane of the cavity, which, being continuous with the mucous membrane of the nose, allows of the escape of the contained purulent fluid into the middle meatus by the natural orifice. In the other case the pus is contained in a sac which has expanded into the antral cavity, carrying the lining membrane before it, and then the pus does not find exit by the nasal opening; this latter condition (as pointed out by Otto Weber) is generally present when the root of a tooth originates the mischief by penetrating the cavity and when an alveolar abscess extends into it, while cysts formed on a root, and dentigerous cysts expand into the cavity in this manner and may afterwards suppurate.

The history of these cases may throw light upon their nature, while a careful examination of the mouth should be made to decide whether the due number of permanent teeth have been erupted, and as to the existence of disease in any tooth in the neighborhood of the tumor. An exploratory puncture or opening should be made in any case that may have a dental origin, before any serious operation is undertaken for the extirpation of the disease.

For treatment it will here suffice to say that the complete removal of any tooth or dental formation involved is demanded, and that for the remaining treatment the ordinary rules of surgery apply.

DISEASES OF THE TEETH.

The largeness of the nerve supply to the dental pulp and periodontal membrane, and the liability to irritation and inflammation to which these confined vascular structures are subject, give an importance to diseases of the teeth which they would not otherwise possess; the pain, direct or reflex, which nearly always attends the involvement by disease of these dental vascular structures, and the serious local lesions which may follow their suppurative inflammation, often cause the mere destruction of the tooth as an organ of mastication to be a matter of secondary importance, although in itself sufficiently regretable. Bearing in mind the description of a tooth given at page 400, it will be understood how the maintenance of a tooth in its usefulness depends on the integrity of its component structures, and how it happens that the pulp and alveolo-dental membrane, which, in a condition of health, are tissues simply subsidiary to the nutrition of the hard structures around them, become—when the tooth is attacked by disease—the parts which have especially to be protected from invasion.

The morbid conditions which may produce irritation of the dental nerves may with advantage be grouped in two divisions.

The first division, including those which cause irritation of the nerves supplied to the pulp with their continuation into the dentine, consists of—

(*a*) Exposure to irritation of sensitive dentine, through loss of enamel resulting from Caries, Erosion, or Fracture.

(*b*) Irritation and chronic or localized inflammation of the pulp when deprived of its protective covering of dentine through the more extended action of the destructive agencies named under (*a*).

(*c*) General inflammation of the pulp, following sooner or later on the previous conditions, and resulting in its sphacelus.

(*d*) Irritation of the pulp through the presence of irregular formations of secondary dentine in the pulp chamber.

The second division, including the morbid conditions that cause irritation of the nerves supplied to the alveolo-dental membrane and to the dental nerves external to the tooth, consists of—

(*a*) Dental Periostitis, *i. e.*, inflammation (plastic or suppurative) of the periodontal membrane. This results by far most commonly from inflammation and sphacelus of the dental pulp; it may be idiopathic, may be produced by irritation of the periodontum at the neck of the tooth where it meets the gum, may be set up by exostosis, and occasionally results from the undue pressure of an opposing or contiguous tooth.

(*b*) Exostosis (*i. e.* hypertrophy of the crusta petrossa), sometimes resulting from, sometimes the cause of irritation and inflammation of the periodontum.

(*c*) A needle-like pointing of the end of the root, and a roughening of its end by absorption.

(*d*) Impaction of permanent teeth in the maxillary bones, and futile attempts to erupt made by such teeth, especially in the case of lower wisdoms.

(*e*) Overcrowding of the teeth.

Irritation of the dental nerves may excite pain at the point of irritation, producing toothache, the pain being either confined to the faulty tooth or being centered in it and radiating to the adjoining teeth and to the nerves of the same side of the face and head, but not infrequently it gives rise to reflex pain, in which case the tooth at fault often escapes suspicion on account of its freedom from pain. More remote sympathetic nerve affections are also sometimes caused by dental irritation.

A most unequal amount of pain or nerve disturbance occurs in different subjects from dental lesions of an apparently similar nature. Such differences must be referred to structural peculiarities of the teeth and to the conditions of health and to the diathesis of the patient.

A faulty tooth is the real origin of many cases of neuralgia about the head and face, although cold or depressed vital power will determine the time of onset.

That remote sympathetic pain may be due to dental irritation will be easily realized by any one who has felt the distribution of his spinal nerves demonstrated on the scraping of sensitive dentine in his tooth.

Toothache (or localized dental pain) varies in character according to the part of the tooth involved; these differences will be apparent as the effects of disease in the several dental structures are considered, but it may be here remarked that a darting pain (which may fade away with an ache) betokens irritation and probable exposure of the pulp—that intense pain of a violent throbbing character points to general inflammation of the pulp and may be expected to cease entirely with the destruction of that structure's vitality, and that the pain which attends irritation and inflammation of the periodontal membrane is of a dull or gnawing character, but may assume a throbbing character if an alveolar abscess is formed.

Hyperæsthesia of the pulp may be expected to coexist with the conditions which act on its nerves, and is evidenced by sensitiveness of the tooth to heat and cold. A hot instrument applied in succession to the crowns of suspected teeth may afford valuable evidence on this point, and tapping the teeth may also reveal the over-sensitiveness of any one tooth. Slight periosteal irritation may accompany this condition.

Dental periostitis at its onset is often attended by a sensation of fulness in the tooth, which inclines the patient to press it firmly into its socket; this sensation is succeeded by painful tenderness on pressure of the tooth, which is often slightly raised and loosened, while the gum, which at first presents a narrow red line around the neck of the tooth, tends to become diffusely red and tender over the root.

In obscure cases of pain the presence or absence of circumscribed periodontitis and of irritation due to exostosis may be diagnosed by pressing the crown of the tooth in different directions so as to tilt the end of the root against the socket; the biting of something hard with one tooth after another may also be adopted as a means of finding out if irritation of this obscure nature is present in a root.

REFLEX NERVE AFFECTIONS DUE TO DENTAL IRRITATION.

The nerves of the second and third divisions of the fifth are more liable than any others to reflex affections due to dental irritation. Next to the several branches of the Trigeminus, the nerves of the Cervical and Brachial plexuses are most often involved.

Neuralgia.—The following are the most common sites for the manifestation of reflex pain.

(*a*) Another tooth to the one in fault, frequently the one that antagonizes it in the opposite jaw, and occasionally a tooth in front of the one irritated (thus, an innocent bicuspid may ache when the wisdom tooth is at fault).

(*b*) The side of the head with the focus of pain near the parietal eminence, due to irritation of a tooth (generally an upper back one) of the same side; this is the source of many cases of unilateral headache.

(*c*) The eyebrow with the focus of pain at the supra-orbital notch, and the cheek with the focus of pain at the infra-orbital notch, the irritation in these cases being located in the upper teeth.

(*d*) From irritation of the back lower teeth there may result earache, and pain extending over the temple, and also pain passing down the neck.

Pain over the upper cervical vertebra appears generally to come on secondarily to the above-mentioned neuralgiæ.

MORE REMOTE NERVOUS AFFECTIONS.

Pain, to quote the words of Mr. Salter, is only one of the phenomena of reflex dental nerve irritation. There may be produced muscular spasm and muscular paralysis, paralysis of some of the nerves of special sense, perverted nutrition. In these pages an enumeration of some of these affections can only be made, and the reader is referred for details of cases to the work on 'Dental Pathology and Surgery,' by the above-named author, and to the second edition of 'Tomes' Dental Surgery.'

The following secondary and remote nervous affections may arise from irritation in the teeth, and be curable by the removal of the exciting cause:—

Convulsions, etc., resulting from irritation in teething.

Epileptiform seizures. In these cases, when an uneasy sensation is felt in the mouth previous to the attack, the best results may be hoped for from stopping or extraction, as the case may demand.

Delirium from retarded eruption of wisdom teeth.

Firm closure of the mouth through chronic spasm of the masseter muscle is a frequent complication of irritation in or about the lower back teeth.

Wry neck. Pain in the course of the cutaneous branches of the cervical plexus.

Partial paralysis of the arm and hand, with an inability to grasp with the fingers, accompanied with aching pain. (Several such cases have recently been under my observation, a fact which shows their comparative frequency.)

Amaurosis. Strabismus. (Ptosis and deafness are also recorded complications.)

Ulceration in the course of a branch of the fifth nerve.

A case of obstinate leucorrhœa and acute uterine pain cured by the extraction of a tooth was recorded by the late Mr. Sercombe.

One case of fatal tetanus is quoted by Mr. Tomes as having followed the operation of pivoting.

Such are some of the reflex pains and remote complications which may arise from dental irritation in a patient of neuralgic diathesis, but apparently similar exciting causes are constantly present without producing any such results.

In an apparently sound tooth an irregular formation of dentine in the pulp chamber is sometimes the cause of neuralgic pain, and may be suspected if hyperæsthesia of the pulp exists in a tooth exhibiting no other causes for over-sensitiveness.

Exostosis and occasionally needle-pointing of the fang may also be the cause of neuralgic pain at the root of a sound tooth, and may have their probable presence revealed by the tooth exhibiting tenderness on pressure into the socket, and perhaps, later on, by other evidences of periosteal irritation. Being otherwise irremediable, extraction is demanded in these not to be foreseen conditions.

With the exception of the above comparatively rare cases it will be noticed by referring to the list of morbid dental conditions given at page 409 that all the affections there enumerated may result from the spread of disease from one dental structure to another, and therefore demand treatment for their prevention and limitation. Thus, when the exterior of a tooth is the first part attacked—as it always is in caries and erosion—the aim should be to preserve the pulp from irritation and exposure, and when the pulp is already exposed through the above diseases or by fracture, the aim should be to prevent its inflammation; while if the vitality of the pulp is past saving, means should be taken to prevent the involvement of the periodontum, and finally, if that tissue is involved, extraction of the tooth may be demanded to relieve pain and to prevent the formation of alveolar abscess with its possible complication of fistulous openings on the face, or the still graver consequences which inflammation external to the tooth may bring about.

Three facts in the nature of a tooth aid dental surgery in its conservative efforts. The first is, that the dense and evascular character of the enamel and dentine allows a diseased portion of them to be removed and the remainder to be preserved by friction, or by a filling inserted in the place of the removed portion.

The second favoring fact is the continued presence on the surface of the pulp of the odontoblast layer of cells, ready to form secondary dentine over the pulp and thus shield it, if they are stimulated to renewed action by irritation of the primary dentine.

And thirdly, the small calibre of the root canal in a perfected tooth, and the minuteness of the aperture that remains at the end of the root for the passage of the vessels and nerves, cause the pulp to be so comparatively isolated, that, when diseased, it can with safety be destroyed by escharotics and be extirpated, before its sphacelus has involved the structures external to the root.

The practical remark may here be made, that up to middle age, probably 90 per cent. of the teeth that are lost owe their destruction to caries, while later in life recedence of the gums and absorption of the alveolus—often prematurely induced by the presence of tartar—leads to the loss of many teeth by depriving them of implantation.

Before reviewing the agencies destructive to the teeth, it will be well to consider the nature of secondary dentine and cemental exostosis, which occupy a debatable position between physiological and pathological tooth formations.

Secondary Dentine.—Three different developments come under this name. The *first*, called by Salter "Dentine of repair," has been alluded to already. The loss of dentine externally through abrasion, caries, erosion, or fracture, will oftentimes produce compensatory development internally—at the point where the affected dentinal tubuli abut on the surface of the pulp; this reparative growth prevents pulp exposure when, from attrition, the enamel and a considerable portion of dentine have been worn away from the surface of a tooth, and sometimes it will obliterate the pulp chamber. In cases of decay "dentine of repair" does not often, unaided, prevent exposure of the pulp, but it hinders it, and becomes a valuable auxiliary in its protective treatment. (*See* Bicuspid, in D, Fig. 243, p. 415.)

Second form.—Cases have been described by Salter and others in which a nodular outgrowth of dentine or osteo-dentine has projected into the pulp chamber of a sound tooth, and has given rise to severe neuralgia. This development must be regarded as morbid, and has been named by the above author "Dentine excrescence."

The *third form* of secondary dentine is essentially an affection of the pulp. "Intrinsic calcification" is the name proposed for it by Mr. Salter, who has described its formation as thus occurring:—Isolated masses of osteo-dentine form, at first usually in the axis of the pulp; these masses enlarge and merge into one another and spread towards the periphery, and may at length occupy the whole of the pulp chamber. This formation may be regarded as sometimes resulting from and as sometimes the cause of pulp irritation.

Exostosis is a term applied to enlargement or outgrowth of the crusta petrosa (see Molar, in E, Fig. 243), ranging in amount from a slight general thickening (when it can hardly be regarded as pathological) to an outgrowth which may double the size of the root and sometimes has fused together the roots of contiguous teeth. The deposition of cementum may alternate with its absorption, and not infrequently it will be found thickened on the upper part of a root where chronically inflamed periosteum exists, while the end of the root will be bare of it and be bathed in the pus of an alveolar abscess. It often causes a globular enlargement of the end of the root. Sometimes small excrescences of it will form on tooth after tooth, and by giving rise to most severe neuralgia will necessitate their extraction.

Exostosis may arise secondarily to inflammation of the periodontum, and will then be accompanied by extra vascularity and tenderness of adjacent gum, &c. The means for detecting its presence in its early stages, when arising primarily and causing neuralgia, have been already mentioned; symptoms that will be likely to attend its prolonged presence as a source of irritation are those of periodontal inflammation.

The nature of the agencies that destroy the dense structures of the tooth will now be considered, and inasmuch as the sequence of disease, when once the pulp is exposed, is much the same whether the exposure has occurred through caries, erosion, or fracture, the treatment of progressive dental disease and the various affections of the pulp will be considered and illustrated once for all; and, finally, dental disease external to the root, with its complications, will receive notice.

The great prevalence of caries at the present day makes it desirable that its nature and the means for its prevention should be understood. These subjects will therefore be discussed somewhat at length.

DENTAL CARIES OR DECAY

may be described as the disintegration of the hard structures of the tooth by decalcification. It always commences on the exterior of a tooth and saps inwards; when the crown is attacked by it, a fault in the enamel is the first step in its course, and may be due to original faulty development or to mechanical or chemical injury.

Fracture may produce the enamel lesion.

A frequent cause of disintegration of the enamel is the attrition exercised by the sides of crowded teeth on each other, and as this sets up interstitial decay a nidus is thereby formed, which serves as a laboratory for the production of chemical destructive agents which act on the adjoining tooth.

The chemical solvents are formed by acids chiefly derived from the buccal mucus and food mixed with saliva, which—lodging between the teeth and in natural depressions—undergo decomposition. In the formation of acid, carious dentine, when once a cavity is formed, takes a part.

A fungoid growth going by the name of "leptothrix buccalis," which is found in the mouth, is constantly present in carious teeth and probably helps in the disintegrating process.

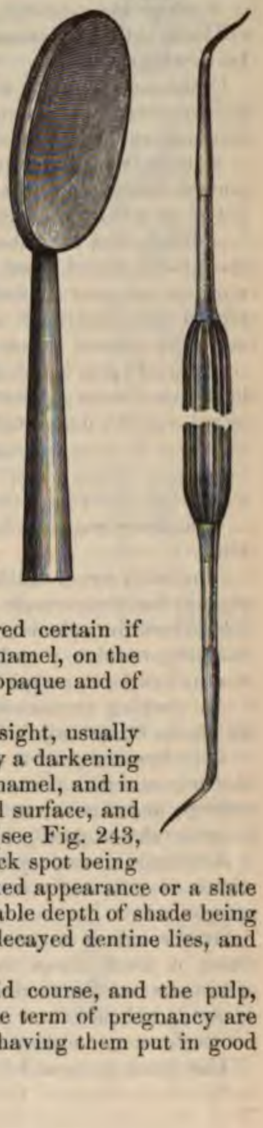
Overcrowding of the teeth, viscid buccal mucus giving an acid reaction, a vitiated condition of the fluids of the mouth due to derangement of the digestive organs, the eating of sweetmeats (as carried by some young people to a most injurious extent), conduce to decay and should therefore be avoided or prevented. The condition of the mouth attendant on fevers accelerates decay.

The great *preventive* of decay is friction, that is, the keeping of the surfaces of the teeth swept clean of the food, mucus, &c., that tend to lodge between or about them. With this object their lingual as well as labial and buccal surfaces should be brushed night and morning; the direction of the brushing should be always from the gum, *i. e.* downwards for the upper and upwards from the lower teeth, as this removes food from between them by the natural lines of clearance; the masticating surface of the back teeth should also be brushed. Where the mucus is ropy and clings to the teeth, a saponaceous tooth powder should be used.

Rinsing out the mouth after meals is a practice to be generally encouraged, and the use of a weak alkaline mouth wash may with advantage be had recourse to, in order to correct undue acidity of the oral fluids, and also to neutralize the local effects of strong acid medicine.

Among preventive measures must be classed what may be termed preventive stopping. For example, a small spot of decay is often found near the distal edge (of the masticating surface) of the second temporary molar; if this be not stopped the decayed posterior surface of the tooth will come in contact with the mesial surface of the first permanent molar on its eruption, and decay be started in it; then on the shedding of the temporary molar, its successor, the second bicuspid, will have its distal surface exposed to decay from contact with that already existing in the first molar, and thus from lack of a small stopping in a temporary tooth, two permanent teeth are frequently lost or only saved by elaborate fillings.

Fig. 242.



The progress of decay is usually very insidious, a minute and unnoticed fault or fissure of the enamel often leading to extensive decay of the dentine. (See decay depicted on masticating surface of molar in D, Fig. 243.) A warning by pain is by no means always given, but sometimes a twinge or slight ache is experienced when the periphery of the dentine is reached and becomes irritated by saccharine or sapid substances or by thermal changes; if this warning is neglected, often nothing more is felt, till an acute twinge shows that the pulp is exposed, or a caving-in of the enamel reveals a large cavity. It thus happens that the detection of decay in its earlier stages can only be insured by frequent inspection of the teeth. Such inspections should begin with the first teeth and be carried out systematically several times a year if the teeth are to be preserved and much stopping avoided.

For the purpose of examination, a mouth mirror and a pointed instrument are required; the double-pointed searcher here figured (Fig. 242) is particularly useful, its curved ends being adapted to pass between the necks of the teeth; it should be employed very lightly in finding out whether a pulp is exposed.

The natural fissures and all depressions of the tooth's surface, together with the sides of such teeth as are in contact, should be carefully examined. A darkening of fissures often points to decay in their depths, and its presence in them may be considered certain if the fine point of the searcher passes through to the dentine. Enamel, on the plane surface of a tooth, when affected by decay, is usually first opaque and of a chalky whiteness, but may become brown or blackened.

In interstitial decay the defect in the enamel, being out of sight, usually escapes detection, and the first evidence of its presence is given by a darkening of the underlying dentine, which darkening shows through the enamel, and in the case of a front tooth is first observable on the lingual or labial surface, and in the case of the back teeth usually on the masticatory surface (see Fig. 243, A). The amount of discoloration varies, sometimes a distinct black spot being visible and showing through the enamel, in other cases a smoked appearance or a slate color being imparted to the affected quarter of the tooth, the variable depth of shade being dependent on the distance from the enamel surface at which the decayed dentine lies, and also upon the character of the decay.

In young teeth, with their deficient density, decay runs a rapid course, and the pulp, being larger, is quickly exposed. The teeth of women during the term of pregnancy are apt to decay rapidly, and to be peculiarly sensitive—a reason for having them put in good order in anticipation of that event.

TREATMENT OF DECAY.

To stay the progress of decay in the hard structures of the crown, two methods are practised, viz., "cutting-out" and "stopping." In either case the affected dental structures must be thoroughly removed and the cavity obliterated.

"Cutting-out" decay is accomplished by removing adjacent sound enamel and dentine, together with the diseased portion, in such a manner that there is left an even surface of hard and healthy tooth, which should be well polished. The full depth to which disease has affected the dentine should be ascertained before the adoption of this method, which should only be had recourse to in healthy mouths, and only in cases where the cut surface will be exposed to friction.

Stopping consists in the removal of diseased structure, in the giving to the resulting cavity a retaining shape, and the insertion into it of a stopping which is made flush with and accurately adapted to the edges of sound surrounding tooth structure.

In practice, cutting-away and stopping are often combined. Dentine left exposed should always be well polished, and if sensitive, camphorated spirits of wine may with advantage be applied to it daily, or it may be touched with chloride of zinc, or in the back of the mouth nitrate of silver or a spirit solution of tannin may be applied to it.

Various materials are used for stoppings.

Gold, skilfully inserted, gives the best results when the tooth is in a condition to bear its introduction.

Amalgams (among which the so-called gold amalgam is very good) can be introduced into a cavity in a plastic state, and therefore can be packed round corners and adapted to thin walls that might not bear the pressure necessary to consolidate gold.

Silicated gutta percha, from its non-conduction of heat and cold, is valuable as a temporary filling, and is particularly well adapted for cavities which pass below the gum; in positions where it is not exposed to the wear of mastication it sometimes lasts for years.

"Osteo," an oxychloride of zinc stopping, has the advantage of clinging to the walls of the cavity, which consequently requires less shaping; it is also non-compressible, which, with its property of non-conduction, renders it valuable as a temporary filling where the pulp is almost or quite exposed. It will not last long if in contact with the gum, and is not to be trusted in interstitial fillings; but for stopping large cavities on the masticating surfaces of teeth in which the pulp is almost exposed, it is a most valuable substance; and if it wears away on the surface, some of it may with advantage be left in the lower part of the cavity, while the upper part is packed with gold. A saturated solution of mastic in spirits of wine (or some such preparation) mixed with cotton-wool, is serviceable as a temporary filling when a carbolic-acid dressing has to be retained in the tooth for any time not exceeding a fortnight.

Whatever stopping is used, the cavity should be kept absolutely dry while it is being filled.

The front upper teeth, which are very liable to interstitial decay, can (especially in the young) be temporarily separated by wedging them apart, thus allowing of their being filled from the side or lingual surface without interfering with their contour or leaving the stopping visible; B and C in Fig. 243 show how hidden cavities in other situations can be reached and stopped, if they cannot be got at by a gradual process of wedging.

In shaping cavities for filling, the proximity of the pulp with its outstanding cornua has to be borne in mind, and its exposure avoided. (*See* Molar, in D, Fig. 243.)

If a healthy pulp is exposed in preparing a tooth for stopping, a cap of some non-conducting material, which has been moistened with carbolic acid, should be at once placed over it, and then a stopping introduced. (*See* Bicuspid, in D, Fig. 243.)

If an exposed pulp has become inflamed at the point of its exposure, and has taken on a secreting action, repeated dressings with carbolic acid to get rid of this ulcerating condition may be had recourse to; and if successful, a stopping may be introduced over the capped pulp; but as a rule, if the pulp has shrunk away from the aperture of exposure, or been the seat of continued pain, it cannot be preserved with comfort, and the best treatment in such a case consists in rapidly bringing about its death by the application of arsenious acid, and then, when it is devitalized, by withdrawing it and thoroughly filling the pulp chamber and its root extensions. (*See* Bicuspid, in E, Fig. 243.)

The accompanying series of drawings, A, B, C, D, E, Fig. 243, illustrate progressive disease in a tooth and its treatment.

FIG. 243.

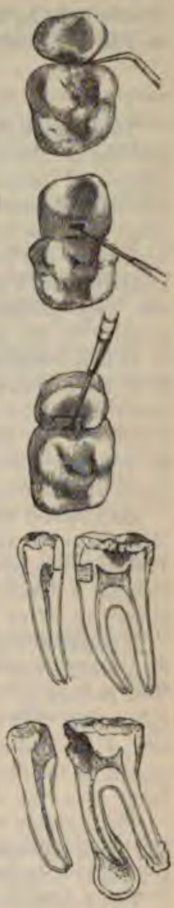


Fig. 243, A, represents the masticatory surfaces of second upper bicuspid and first molar. The darkening of the decay beneath shows through the enamel on the bicuspid. A searcher is introduced to explore the mesial surface of the molar for decay.

Fig. 243, B, the same teeth; the front surface of the molar, having presented superficial decay, has been chiselled down, which gives space for stopping instruments to be brought to bear upon the deeper cavity in the bicuspid.

Fig. 243, C, the same teeth with decay more advanced. The cavity in the front of molar, proving too deep for "cutting-out," is reached by stopping instruments introduced *via* the cavity in the bicuspid. The latter tooth having had the enamel on its masticatory surface too much undermined for preservation, will have its contour restored by a stopping introduced into the dovetailed-shape cavity, here seen from above.

Fig. 243, D, represents continuation of disease as seen in vertical section of lower bicuspid and first molar. In the bicuspid the pulp has been just exposed, but being healthy has had a carbolized cap and a non-conducting stopping placed over it, and has developed a protective shield of secondary dentine. A gold stopping is seen in the molar, of a shape that would insure its retention if solid. Commencing decay is also shown at the masticating surface of this tooth.

Fig. 243, E, same teeth. The pulp of the bicuspid is supposed to have been destroyed with arsenious acid and withdrawn from the pulp chamber, which, with its extension to the end of the root, is represented as filled, the lost portion of the crown being also restored. The effects of unchecked disease are seen in the molar, the anterior root being occupied by purulent fluid, and its apex bathed with pus of an alveolar abscess. The posterior root, in which some living pulp still remains, is represented as exostosed, but might with equal truth have been depicted as covered with thickened and inflamed periodontum.

When a pulp has been extirpated immediately after its loss of vitality the root canals should be stopped to their apices forthwith, but when a dead pulp has remained in a tooth for any time a thorough purification by the use of carbolic acid must precede the stopping.

In some cases after the pulp has been extirpated, instead of filling the roots, an alternative plan must be adopted if the tooth is to saved.

This consists in drilling a fine canal beneath the free edge of the gum into the emptied and cleansed pulp chamber, which is then covered over with a cap and superjacent stopping.

Fig. 244 represents a tooth so treated—the gum in this case acts as a valve opposed to the ingress of food, &c. The vent (which may be made through a stopping), by preventing the accumulation of fluid or gas in the pulp chamber, stays the development or allows the subsidence of inflammatory mischief about the root.

FIG. 245.

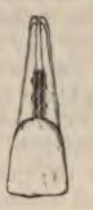
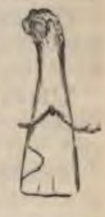


FIG. 244.



Pivoting.—When no other teeth want replacing and the crown of one of either of the six upper front teeth is lost through fracture or decay, the operation of pivoting a new one on to the root is much to be preferred to other modes of attachment.

In the case of a healthy root the crown can with advantage be pivoted on it once for all, after the end of the canal has been filled with gold or other durable stopping; but in other cases the following mode of operating is to be preferred:—The canal at the end of the root is left open, and the new crown is affixed to the root by a split gold pin which is sheathed in a platinum tube fixed with stopping into the rifled barrel of the root. Here the tooth crown can be removed and replaced at pleasure, while the root is preserved from further decay by being lined with metal, and by this method a root not fully formed, or one that is the subject of alveolar abscess, may safely be used for supporting a pivoted crown. (See Fig. 245.)

Decay at its commencement is, as a rule, capable of satisfactory and quite or comparatively painless treatment. The difficulties of its successful treatment increase with its onward progress, while the nerve complications that have been noticed, and the severer inflammatory lesions which will be enumerated further on, are most frequently the sequelæ of neglected decay.

FRACTURE OF TEETH.

Teeth, especially projecting upper incisors, are liable to be fractured. If only a small portion of the crown is chipped off, the fractured edge may be smoothed with a file or stone and touched with spirit to keep it hard and insensitive (filing to amend shape should not be had recourse to while the patient is very young). If the portion broken off is so large that the tooth will be permanently disfigured and yet the pulp has escaped destructive irritation, the tooth may for a time be left as it is, or the remainder of the crown may be removed and a new crown pivoted on to the root; in a young subject the destruction of the pulp preparatory to pivoting should be postponed until it is reduced to its ultimate tenuity by the perfecting of the root.

If it is evident that the pulp has become inflamed through the facture it will be desirable to at once destroy and extirpate it, in order that the periodontum may be preserved in a healthy condition, and therefore the root be in a position to carry a pivoted crown with comfort. In young subjects, when the teeth are much crowded and relatively prominent as compared with those in the lower jaw, it may be desirable to extract the fractured tooth and to train-in the neighboring teeth to occupy its site.

Arrested or carbonized decay.—Sometimes in young subjects when the enamel is lost almost simultaneously over the whole masticating surface of a molar tooth, decay becomes arrested, the exposed dentine assuming a dark mahogany or black color, and presenting a density which qualifies it for mastication. Such a result may be aided by the rounding-off of projecting enamel edges.

Erosion.—Occasionally the enamel and subjacent dentine are gradually lost by a process which was called by Hunter "decay by denudation," and by recent writers erosion. The surface of the cavity so formed remains hard and polished and often free from discoloration. It is probable that this gradual wasting away of the tooth substance, without any of the ordinary appearances of caries, is due to the combined action of chemical solution and friction; the enamel in the first instance being affected over a comparatively large area, the dentine, when reached, is exposed to friction which prevents its softening.

This erosion may affect other parts of a tooth, but usually attacks the labial surface at the neck; frequently many teeth in the same mouth are affected by it, a groove being gradually scooped in the teeth just above the gum until the pulp is exposed.

TREATMENT.—An alkaline mouth wash should be prescribed; horizontal brushing interdicted, and if the exposed dentine is sensitive either of the solutions mentioned at page 414 may be applied to it. In cases admitting of it, stopping should be had recourse to, that the pulp may be preserved from exposure.

AFFECTIONS OF THE PULP.

An exposed dentinal pulp is subject to mechanical, thermal, and other irritation. The pain produced by such irritation is of a sharp lancinating character, sometimes passing away with an ache.

Chronic inflammation.—Circumscribed superficial inflammation with increase of sensitiveness may be developed in the pulp at the point of exposure, and may continue for a long time in an unsuspected cavity, giving rise to reflex pain or (so-called) neuralgia.

Ulcerative condition.—The exposed surface of the pulp may take on a secretive action, and the tooth be free from pain as long as the exuded sero-purulent fluid finds an exit, and the pulp escapes fresh irritation.

Acute or general inflammation of the pulp is attended by terrible pain of a violent throbbing character, which, after lasting several hours or days, may cease as suddenly as it began, its cessation betokening the death of the pulp. In this case every factor for the production of agonizing pain is present, the distensible pulp, largely supplied with nerves, undergoing vascular engorgement with an unyielding case (closed-in at all parts except at the aperture of exposure, through which it may bulge and suffer further constriction). The pain is not usually confined to the faulty tooth, but spreads from it to the neighboring teeth and to the side of the face; during the paroxysms the tooth often becomes tender to pressure, owing to a sympathetic irritation of the periodontal membrane. Prompt measures should be taken to prevent the products of decomposition which result from the sphacelus of the pulp from passing beyond the interior of the tooth and so causing the inflammatory involvement of the periosteum and the formation of alveolar abscess. The pulp occasionally loses its vitality without producing noticeable pain.

Tardy destruction of the pulp.—Instead of losing its vitality at once the pulp may die piecemeal, the chronic irritation that attends this process being often productive of morbid changes on the exterior of the root. A pulp chamber that contains the remains of a decomposed pulp emits a strong and peculiar phosphatic smell.

Classification of pulp has been described already under the head of *Secondary dentine.*

An insensitive polypoid growth of the pulp, consisting of granulations which throw off a secretion and readily bleed, sometimes projects from the pulp chamber into a cavity in the crown of a tooth; it usually necessitates the extraction of the tooth on account of the successful resistance it offers to extirpation.

A sensitive sprouting of the pulp may follow fracture of a tooth. Extraction would be the treatment for this condition, which, by extirpation of the pulp, should be prevented from developing, if the retention of the root is desirable.

Necrosis of the pulp may occur within the unopened pulp chamber of a sound tooth. It is most often consequent on a blow (sometimes a very slight one) rupturing its vessels as they enter the apex of the root. It may supervene on fever. A darkening of the whole tooth results, and is due to the permeation of the dentine by the decomposed coloring matter of the blood.

Salter has pointed out that the pulp thus devitalized may be disposed of by fatty degeneration. In the absence of treatment (*i. e.*, extirpation of the pulp, &c.) it often leads to alveolar abscess.

A tooth knocked out and immediately replaced may become quite firm and obtain vital connection with the alveolo-dental membrane, and will then be in the same condition as the above. Death of the pulp will be evidenced by the absence of a sensation in a tooth when touched with an instrument hot enough to evoke sensation in its neighbors.

AFFECTIONS OF THE ALVEOLO-DENTAL MEMBRANE.

Dental periostitis may be local or general, chronic or acute.

General inflammation of the periosteal investment of the teeth and their sockets results from rheumatism or attends on a debilitated or unhealthy conditiom of the system, and demands constitutional treatment. When slight in amount and causing only a loosening of and sense of fulness and uneasiness about the teeth, no local treatment may be required beyond the use of a slightly astringent mouth wash. When the gums are also congested they should be scarified and a stronger astringent (tannin dissolved in spirits of wine is efficient) applied to them. Tincture of iodine is a favorite application with some. Any root or tooth that may be an excitant of inflammation is best removed, and tartar should be thoroughly got rid of from beneath the free edges of the gum.

The continuance or oft-repeated recurrence of a congested condition of gum and periodontum leads to the absorption of the alveolar edge and consequent loss of implantation for the teeth; the gradual deposition of tartar upon the root, besides being one of the commonest causes of this condition, is apt to attend upon and increase it when arising from other causes. When the periosteal inflammation is more acute and pus is formed about the necks of the teeth, a solution of chloride of zinc—8 grs. to the ounce—will be found a beneficial mouth wash and will correct fetor.

The general symptoms of dental periostitis have been given at page 410; it may be added that when due to rheumatism, toothache is apt to be present and swelling and suppuration absent, and that it will often subside of itself, while in a scrofulous subject, or when due to syphilis, the pain is often slight and the tendency to suppurative inflammation marked, and that in these cases the loss of the teeth is imminent and that their extraction at once may be desirable. Periostitis of the alveolar process of the jaw, leading to necrosis, may be caused by syphilis, sloughing of the gums, or alveolar abscess, or may have a traumatic origin.

The fumes of phosphorus, productive of "phosphorus necrosis," probably find a readier ingress when the pulp of a tooth is exposed, and other irritants productive of periosteal inflammation may act through the same channel.

Necrosis of the alveolar portion of the jaw in children may follow either of the exanthemata, and will not always lead to the loss of the permanent teeth if due time is given for the separation of the necrosed portion.

Inflammation of a subacute type may attack the periodontum of one tooth after another and lead to their successive loss in cases where the roots of the teeth are exposed through the recedence of the gums and alveolar margin from senile absorption or other causes.

Local Dental Periostitis.—With the exception of the condition just named, inflammation attacking the alveolo-dental membrane of a single tooth results from pre-existing disease in the tooth or is due to some local cause of irritation, such as a ligature applied carelessly for regulating purposes or for fracture of the jaw, the accumulation of tartar, or the undue and oblique pressure of an antagonist tooth. Chronic inflammation and thickening of the periodontum is often complicated either as cause or affect with exostosis or with a very small chronic alveolar abscess about the apex of a stump, and is, in these cases, associated sometimes with severe neuralgia, the pain simulating that of tic-douloureux.

The Dental Cysts which sometimes form on the roots of teeth are probably generally the outcome of conditions which in their more sthenic form lead to the formation of alveolar abscess. An alveolar abscess may pass into a cystic condition, and it is certain that these cysts (which may contain cholesterine) may suppurate, and then to all intents and purposes they become converted into alveolar abscesses.

Periodontal inflammation of an acute form, producing **Alveolar Abscess,** is the natural sequel of death of the pulp, the products of the decomposition of this structure passing through the foramen at the end of the root, giving rise to it. Pus formed between the root and its investing membrane may separate the latter from the former and escape around the neck of the tooth, in which case, if the dentinal pulp is also dead, the tooth becomes absolutely necrosed and is to be regarded as a foreign body. Pus may become diffused beneath the gum, and this is especially likely to occur in the case of lower impacted wisdom teeth. Far more commonly, pus, derived from the pulp chamber or due to the breaking-down of inflammatory lymph, which has been thrown out about the apex of the fang, is contained in a circumscribed abscess which embraces the end of the root (*see* Fig. 243, E) and occupies an excavation in the maxilla. Preventive treatment consists in the complete clearing-out of the root canals and their thorough purification with carbolic acid, this, with the administration of a saline purgative and the local abstraction of blood by the application of a leech to the gum over the root, affords the best chance of cutting short periodontal inflammation that tends to the formation of abscess. The formation of an alveolar abscess is usually preceded by great local tenderness to pressure on or over the root of the tooth, and attended by pain of a throbbing character, sometimes by rigors and considerable constitutional disturbance. The possible occurrence of pyæmia from this cause is not to be overlooked. Great serous effusion into the cancellated bone and the soft surrounding tissues not infrequently takes place, mistaken sometimes for erysipelas and occasionally resulting in suppuration; the closure of the eye of the affected side, or a swelling from the lower jaw reaching half down the neck may thus be produced. An abscess connected with an upper molar sometimes causes a fulness over the lower jaw. When an abscess is formed the contained pus tends to find an exit either through a gumboil (so-called), or by a fistulous opening on the face, etc.; an opening on the gum being naturally formed when the mucous membrane is reflected from gum to cheek at a distance from the alveolar border, and a canal through the body of the bone, if the root of the tooth extends below such reflection of the mucous membrane.

An alveolar abscess attached to the upper teeth may perforate the antrum, when attached to an incisor may open into the nares, or when connected with a lateral incisor may pass backwards between the compact layers of the palatine process of the superior maxilla or between the periosteum and the hard palate, and open through or behind the soft palate. It may also form fistulous openings on the face near the inner canthus or under the edge of the malar bone. An alveolar abscess connected with lower incisors may open under or in front of the chin, and above or under the margin of the jaw when connected with the other lower teeth; from a wisdom tooth the pus may pass forwards to the canine, backwards to the fauces, or escape at the angle of the jaw. Pus from an alveolar abscess may pass down the neck, and in one case it found final exit below the clavicle, and in another and fatal case it reached the armpit.

The pus of an alveolar abscess that distends the mucous membrane of the gum or cheek should of course be evacuated by an incision, if the extraction of the tooth does not suffice for the purpose. A chronic gumboil may be regarded as a safety vent; but abscesses with such a fistulous opening on the gum may sometimes be cured by pumping carbolic acid through the root of the tooth until it escapes on the gum, followed up by stopping of the root.

When alveolar abscess has formed and does not tend to open on the gum, but causes a distension of the bone over it, together with local inflammation, the tooth, as a rule, should be extracted without delay to prevent further mischief, although in some cases a clearing out of the pulp chamber and the performance of rhizodontropy, coupled or not with a direct opening into the abscess to evacuate the pus, may be the right practice.

In alveolar abscess of the lower jaw, a prominence passing out from any diseased tooth and obliterating the natural sulcus between gum and cheek will point to the tooth which should be extracted, and a vertical incision across the abscess track within the mouth may be advisable to prevent the next step in the formation of an external fistulous opening, namely, the distension and thinning of the skin preparatory to its perforation. In these cases warm water should be held in the mouth, and poultices should *not* be applied to the outside of the face.

A fistulous opening on the face, which has given exit to a continual discharge for years, will at once close up on the extraction of the tooth or buried root which has caused it, but a permanent depressed cicatrix will be left; in these cases a probe introduced from the outside will very likely impinge on something which feels rough and hard like dead bone, but is really an exostosed and roughened tooth fang; absence of fetor in the discharge and singleness of the opening point to the presence of a diseased tooth and not bone disease.

Serious local Complications of Inflammatory Action set up by Tooth Disease.

The disfigurement of a fistulous opening on the face, due to neglected alveolar abscess, is comparatively common, but far more severe complications are sometimes but very rarely produced by the inflammatory involvement of surrounding structures. The seventh nerve has thus been involved, producing facial paralysis. Necrosis of the involved bone has led to a fatal result. Several cases are detailed by Salter in which permanent loss of sight in one eye followed antral abscess or inflammation about the upper teeth. In one case amaurosis of thirteen months' duration was got rid of by the extraction of a carious tooth from the end of which a splinter of wood projected. In the case of a patient who recently came with symptoms of tumor in the orbit into Guy's and there died, Dr. Goodhart traced the origin of mischief to caries of the first left lower molar, which gave rise to abscess, suppuration in the inferior dental canal, acute ostitis of left side of lower jaw, extension of disease by pterygo-maxillary fossa to orbit, suppuration in both orbits, ostitis of vault of skull, and pyæmia.

The spasm of the masseter which frequently attends disease about the lower back teeth is sometimes probably due to inflammatory involvement of the nerve, and not simply to reflex irritation. Extraction of the tooth is its cure, and the mouth may be opened sufficiently to allow of this being accomplished by the persevering use of a wedge between the teeth.

Tartar or salivary calculus consists of lime salts precipitated from the oral fluids, together with "leptothrix buccalis," epithelial scales, &c.; it especially tends to form on the lingual surface of the lower front teeth, and on the buccal surface of upper molars; a small rim may be often found on all the teeth under the free edges of the gum, which may then present a narrow blue line or be generally congested. Brushing in the manner recommended for the prevention of decay checks its deposition. Its presence in large mass may cause ulceration of the tongue, &c., and in much smaller quantity causes loosening, and if allowed to accumulate, the loss of the teeth. It should be carefully and thoroughly removed with small scaling instruments, used so as not to make the gum bleed.

All teeth that are retained in the mouth should by stopping and scaling be rendered as sound and firm as possible. A patient with tartar-loaded and decaying teeth may travel for fresh air, but will hardly find it.

All sharp and jagged edges of teeth should be removed by a file; this is of special importance in after-life, as localization of epithelioma of the tongue is commonly traceable to irritation so produced.

TUMORS AND OTHER AFFECTIONS OF THE GUMS.

Sundry gum affections are intimately connected with the teeth.

Simple hypertrophy of the gums, chiefly on their labial surface, is sometimes met with when the teeth are overcrowded, the gum being shut out, as it were, from between the neck of the teeth. The preventive treatment for this condition is self-evident, but when it is established, and extraction is inadmissible, it may be reduced by free scarification and the application of tannin, &c.

Occasionally, in unhealthy subjects, hypertrophy assumes larger proportions, the crowns of the teeth being buried in lobulated masses of gum. The treatment consists of scaling, free scarification (and sometimes excision), together with the local use of astringents and fetor-correcting applications. Absorption of the underlying alveolus, and consequent loss of implantations for the teeth, is apt to attend upon this hypertrophy, as it does upon continued extra vascularity of the gums.

A polypus of the gum is frequently found to project into dental carious cavities which extend below the gum; it is vascular and insensitive, and should be cut away and picked out of the tooth cavity preparatory to the filling of this latter. This gum polypus is sometimes liable to be mistaken for polypus of the dentinal pulp.

Epulis.—The tumors classed under this name present, in varying proportions, a fibrous or myeloid character, and not infrequently have small osseous development at their bases. As regards the maxillæ, these growths essentially belong to the alveolar or tooth-bearing portion, and consequently can, as a rule, be completely removed without interference with the basal portion of the bone. The fibrous tissue of the gum, the endosteum, and the alveolo-dental membrane having continuity, may each share in the development of an epulis; it therefore follows that for the complete eradication of the disease, the extraction of an adjoining tooth or root may be demanded, together with the excision of the growth and involved bone.

Vascular tumors.—My colleague Mr. Salter has recorded a case of a vascular tumor the size and color of a Morello cherry, which he found attached by a narrow neck to the periosteum of a tooth. In my own practice a lobulated tumor, of polypous character, and having much the appearance of an epulis, overlapped the hard palate, and was found to be attached by an exceedingly narrow pedicle to the edge of the periosteum of a decayed molar tooth. In both these cases hemorrhage of a really alarming extent had occurred, and in both the tumor was removed by extracting the tooth.

The painful "ulcerative stomatitis," so frequently met with in hospital practice among young children, often demands the extraction of loosened and irritating teeth, coupled with the internal administration of its specific remedy, "chlorate of potash."

THE EXTRACTION OF TEETH.

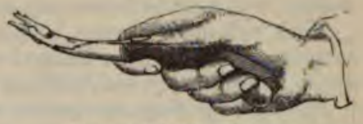
Speaking generally, extraction may be required for regulation of teeth, which includes the prevention of overcrowding; to prevent or get rid of impaction of a wisdom or other tooth; for neuralgia and nerve irritation when its origin in a tooth is not confined to some condition of the pulp which can otherwise be got rid of. As a rule, in cases where periodontitis (not rheumatic) is established and resists curative treatment; when an alveola abscess tends towards opening externally; in cases of vertical fracture of the tooth; i the case of loose and diseased teeth or roots which keep up an unhealthy condition of th mouth; when an epulis has probable connection with alveolo-dental membrane; and finally, in some cases to allow of more satisfactory artificial restoration.

Forceps and Elevators are the instruments now used for the extraction of teeth. Th forceps adapted for the removal of the different teeth will be found described in ‘Tomes Dental Surgery,’ and only a few special points will be here noticed with regard to the and their use. Forceps should be finely made and well tempered, with blades whic should grasp the tooth's neck without pressing on the crown, as extraction is seldo required for sound teeth, but for those that are broken down or hollowed out by decay.

In extracting a tooth the forceps should be applied lightly but closely to its neck a then sent firmly up (or down, as the case may be) until they grasp a part of the too that will resist some pressure; the edges of the blades will thus, as a rule, be made pass just within the edges of the socket, while in the case of the molars the points of t blades will take grip at the bifurcation of the roots; the right hold being obtained by th first movement, the instrument is thenceforth kept at one with the tooth, which is fi separated by a particular movement from its socket attachments and then withdrawn.

The accompanying drawing, Fig. 246, shows the manner of holding the forceps. The little finger may be used as a kind of opening spring, and the thumb should act as a stop between the handles and prevent any crushing pressure.

Fig. 246.



Manner of holding forceps.

The particular movement required for the dislodgment of a tooth depends on the shape of its root. Thus, the upper incisors and canines, together with the lower bicuspids, are more or less conical, and are therefore to be rotated, while the lower incisors and canines, together with the upper bicuspids, are more or less flattened from side to side, and therefore are to be moved outwards and inwards. The molar teeth are also to be moved outwards and inwards before being extracted.

The direction in which teeth are withdrawn from their sockets depends on the position held by their roots. Upper molars are extracted downwards and outwards; lower molars upwards, and often somewhat backwards; while in order to follow the curves of their respective roots, upper wisdoms should be extracted downwards, backwards, and outwards, while the crowns of lower wisdom teeth should be carried backwards and upwards.

An elevator should not be used in extracting the upper wisdom tooth on account of the fragile nature of the tuberosity of the maxilla in which it is lodged, but may sometimes be used with advantage for a lower wisdom when the second molar is sound and firmly implanted.

Before attempting to extract a buried and impacted lower wisdom tooth a careful examination should be made with a probe to see how it is situated; sometimes it will be found to hold a horizontal position, its crown impinging upon and causing absorption of the root of the second molar. In cases where it is possible to extract the impacted tooth, lower hawksbill stump forceps with a double curve and an elevator such as shown in Fig. 248, B, will be found very useful. In cases where the ascending ramus would be necessarily injured in attempts to remove the wisdom, the second molar should be extracted and then the buried tooth may erupt without further trouble, or can be easily removed if still a source of irritation. Stump forceps, as here figured (Fig. 247), are far better adapted for the extraction of bicuspids than the so-called bicuspid forceps.

Fig. 247.

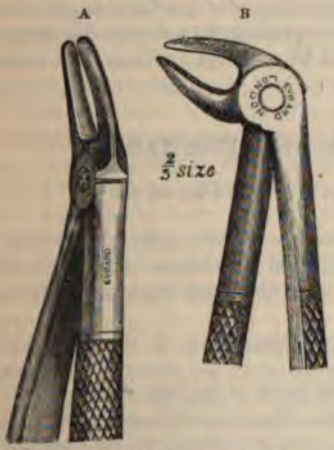


Fig. 248.

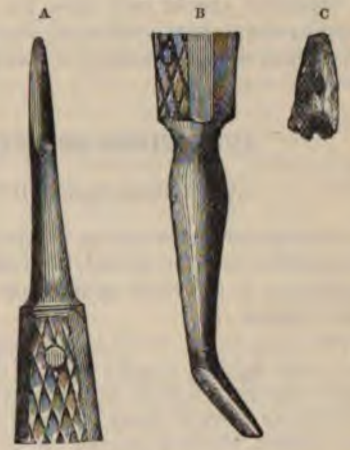


Fig. 247.—A. Upper stump forceps. B. Lower stump forceps.

Fig. 248.—Wedge-shaped scoop elevators, which are very useful in extracting buried or much hollowed-out roots such as C. A. Elevator for upper roots. B. One of a pair of elevators, devised by Mr. C. Rogers, for lower stumps. Such a root as C may sometimes be best removed from the upper jaw with an instrument having a spiral cut on it, used like a corkscrew.

In the case of a much broken-down or hollowed-out lower molar, instead of using molar forceps, it is better to grasp with stump forceps the one of the two roots which offers the best hold, and if the union between the roots is not strong enough to allow of their withdrawal together, the remaining separate root will be easily removed.

The three undivided roots of a crownless upper molar may be extracted with "Coleman's forceps," or with long flat-bladed, loose-jointed stump forceps as made by Collins.

Occasionally dividing forceps may be used with advantage in extracting united roots of either upper or lower molars.

When a root is partially covered over with gum the position of its edges should be defined with a probe before any attempt is made to grasp it.

With well-made forceps, lancing the gums before extraction is usually unnecessary, but sometimes, especially in isolated teeth, the gum is strongly adherent to the tooth and is apt to be torn away with it if not first separated.

Fistulous openings on the face are seldom seen in connection with children's temporary teeth, but the external alveolar plate is often perforated, and the end of a root projects through and causes ulceration, which may lead to adhesion between gum and cheek; the teeth causing this irritation are easily pushed out with an elevator.

Persistent hemorrhage following the extraction of a tooth and resisting cold may be stayed by tightly packing the socket with rolls of softened matico leaf (Tomes), or with a strip of lint cut to a point and dipped in a spirit solution of tannin, a compress being placed over and kept in place by the opposite teeth. At the same time astringents or iron should be given internally if the hemorrhagic diathesis exists, or appropriate measures be taken if the bleeding in the case of a woman appears to be vicarious.

When natural teeth are lost, artificial ones unquestionably conduce to comfort and health.

In elderly people teeth that project in an unsightly manner can often be shortened with much advantage and without pain. The roots of upper front teeth and of lower teeth, if healthy, may often be retained in the mouth with gain. The wholesale and indiscriminate extraction of teeth is to be strongly reprobated, leading, as it does, to premature absorption of the alveolar processes, and thus often reducing in middle age the lower jaw to a level with the root of the tongue, and, therefore, ill-fitted to support artificial teeth. Several painful cases resulting from extreme absorption, due to this practice, have lately been seen by me.

In the cases of cleft or perforate palate which are not amenable to surgical treatment, artificial restoration should be had recourse to.

An obturator should only span the orifice in recent cases of perforation, in order that occlusion by the approximation of the edges of the opening may not be interfered with, and in no case should a method of fixing in the plate be used that will tend to enlarge the aperture.

AFFECTIONS OF THE PHARYNX AND ŒSOPHAGUS.

Inflammation and Suppuration of the Pharynx

is met with in the feeble and cachectic subject, and comes on with general and local symptoms not unlike those of quinsy, both affections being often associated. Pain with difficulty in swallowing is the chief local, while fever with constitutional disturbance is the chief general symptom.

Abscess may be the result of an acute or chronic inflammation of the part, and shows itself by some bulging or projection of the mucous covering of the pharynx. It may be so large as to interfere with if not prevent deglutition, or even to impede respiration. I have seen this occur twice in cases of spinal disease. When these conditions exist, the abscess must be opened, the best instrument to use being a straight bistoury protected up to the point by a piece of lint or strapping. An instrument called a pharyngotome has been devised for the purpose, and answers well, but the bistoury is preferable. Tonics, such as quinine, iron, or the mineral acids, are almost always required in these cases. Steaming the throat gives great comfort, as well as external warm applications. Nutritious food should always be allowed. The surgeon should remember that a post-pharyngeal abscess may be due to disease of the vertebræ or base of the skull, but such cases are generally chronic.

Tumors of the pharynx may also give rise to the external appearances of a chronic abscess by pressing the mucous membrane forward, and cancerous tumors are very liable to do this. One of the most marked cases of the kind I ever saw turned out to be a syphilitic gummatous tumor which was so large as to make me suspect its cancerous nature, but, on investigation it proved to be syphilitic, and was cured by ten-grain doses of the iodide of potassium in bark three times a day.

The cancerous tumors generally commence in the upper part of the pharynx, and cause obstruction of the posterior nares; as they grow downwards they simulate a pharyngeal polypus. Two such cases in young people have been under my care, and both died. It was a question in both whether the disease was not originally in the tonsil, but it appeared to have originated above the gland.

DYSPHAGIA

is merely a symptom, and due to numberless conditions, which cannot be treated till the cause is known. To ascertain this is consequently most important, and should always be done by eliminating every possible cause. It may be that the symptom arises from some want of power in the pharyngeal muscles or from œsophageal *ulceration* or obstruction. If the former cause holds, the condition may be due to a paralysis of the muscles of the part from cerebral disease, to hysteria, or to diphtheria—as under all these circumstances there may be a more or less complete loss of power in the act of swallowing—food or fluid passing into the nose or the larynx producing suffocation. This condition is often present after the operation of tracheotomy for croup, the want of adaptive power in the muscles of deglutition allowing liquid food to travel down the larynx and appear at the external tracheal wound. Laryngeal and pharyngeal tumors and tumors about the base of the tongue, can also produce the same symptoms.

When dysphagia is due to œsophageal obstruction, it may arise from spasmodic or organic stricture of the tube itself, or, to the presence of cancerous, syphilitic, or simple ulceration; when to pressure from without, to some thoracic, cervical, or aneurismal tumor, or to the presence of a foreign body in the tube.

Stricture of the œsophagus, as a rule, takes place at its upper end behind the cricoid cartilage, though it may also occur at other parts. It may be *spasmodic* or hysterical, but more frequently is associated with some kind of *ulcerative* action, simple, syphilitic or cancerous; occasionally it is *cicatricial*, the result of a former injury, such as the swallowing of a corrosive fluid. In the majority of cases, however, the disease is due to cancer. It is a great question whether a simple fibrous stricture of the œsophagus, such as is found in the urethra, ever takes place. *Thoracic aneurism* is capable of producing every symptom of this affection.

Spasmodic or hysterical stricture is usually met with in the young, but it may be found at all ages. Paget has described it as a kind of stammering of the muscles. It is probably always associated with some local irritation, follicular inflammation or ulceration. This may have originated by itself, or been caused by an injury such as a scratch from the passage of a hard or sharp body. It is, moreover, usually associated with dysphagia. The dysphagia is likewise intermittent and uncertain; as when a patient is given food or fluid to test her power, it will be said that it is impossible to do what is required, and should it be attempted to a certainty the sufferer may half choke. Yet, at other times when otherwise engaged, food can be taken. If a probang be used to examine the part, its introduction will be violently opposed by the pharyngeal muscles, though with a little steady pressure, all obstruction will be overcome.

ŒSOPHAGEAL OBSTRUCTION.

When a patient complains of a difficulty in swallowing, or rather of difficulty in passing food onwards down the œsophagus after the act of swallowing has been performed, and of its subsequent return into the mouth, the surgeon in looking for its cause should first think of thoracic aneurism, then of cancer of some portion of the tube, and, lastly, of simple ulceration. He should also always inquire into the history of the case, and satisfy himself that in no previous period has the patient sustained any local injury from the swallowing of boiling water or corrosive fluid. If the last cause be eliminated, and a careful examination of the chest with other modes of investigation dispose of the question of aneurism, then that of cancer becomes the most important, as there is little doubt, that such, in the majority of cases of organic stricture of the œsophagus, is the true cause. In the early stages of the affection, the diagnosis is difficult, indeed at this period, the surgeon is seldom consulted, for so long as solid food passes, the patient is hardly aware of any obstruction existing, as the habit of swallowing small boluses of food grows *pari passu* with the obstruction. An attack of spasm is perhaps the first symptom that attracts notice, spasm which completely closes the canal, and causes *regurgitation* of the food.

At this early period of the disease the surgeon will probably be able to pass a probang, though it may be only a small one. As the disease progresses some signs of ulcerative action may appear, such as the discharge of pus or blood, which usually comes up with the regurgitated food, and when this occurs there is no better indication of the presence of ulcerative action. If the patient be middle aged, the probabilities of the disease being of a cancerous nature are very strong, and should there be any local thickening behind the larynx or glandular enlargement, these probabilities are enhanced. When, however, the patient is a young adult, and a history of syphilis exists, its syphilitic nature is rendered probable, as simple or syphilitic ulceration of the œsophagus is sufficient of itself to cause complete œsophageal obstruction, simulating stricture—the spasmodic contraction of the muscles of the tube having much to do in bringing about this result. The following case, which occurred in a patient of Dr. Habershon's, illustrates these points very forcibly:—The patient, æt. 48, was dying from starvation caused by inability to swallow on account of œsophageal disease, and for it I performed the operation of gastrostomy. The man lived six days afterwards, and died of pneumonia. After death, nearly a complete ring of ulceration was found at the upper part of the œsophagus, which had caused all his symptoms. Its syphilitic nature could not be decided, although the man gave a history of having had the disease twenty years previously. The repair at the seat of operation was most complete, the stomach and integuments having firmly united. No peritonitis existed.

I once saw, in consultation with Mr. Pink, of Greenwich, and Dr. Wilks, a case of complete œsophageal obstruction which we all believed to be cancerous, but which so far improved under the expectant treatment as to allow of the passage of well-minced food with comparative comfort. Several months later, however, complete dysphagia returned, and the man died, a direct communication having taken place between the œsophagus and the respiratory tract from extension of the cancerous ulceration. Had a bougie been passed in this case, a fatal result would probably as a consequence have taken place.

As the disease progresses other symptoms will appear, for the ulcer may eat its way into the larynx or trachea, when it soon proves fatal. It is from this fact that the surgeon should always be very chary of passing any bougie down the œsophagus, because when ulceration has taken place, he will be very liable to do harm, and may cause perforation of the ulcer into the air-passages, or even the pleura.

TREATMENT.—Assuming the pathology of stricture of the œsophagus which has been given to be correct, the treatment by dilatation is not only useless but dangerous *except* when the stricture is of *the cicatricial form;* for when it is due to cancerous or other ulceration the irritation of a bougie must do harm, and the passage of an instrument is likely to hasten the fatal termination of the disease. In the cicatricial form, however, or that which follows some local injury, such as can be produced by an irritant fluid, dilatation is of great value, and such treatment if it does not cure the disease will at least prolong life. A bougie as large as can be passed should be introduced daily, and retained. The patient should, when possible, take solid food finely minced, and when otherwise, fluid nourishment. Milk can often be drunk when other food is refused. Beef tea is always useful, and Hassall's flour of meat mixed with it is an excellent addition. Brand's liquid essence of meat is also invaluable.

When swallowing becomes impossible, the cautious passage of a fine tube through the stricture for the introduction of liquid food may be undertaken, though this proceeding is hazardous, and can rarely be repeated for many days. Nutritious enemata appear to me to be preferable, beef tea thickened with flour or arrowroot, with milk and egg, or a mixture of a pound of minced beef and one-third of a pound of fresh pancreas, one-half of which being introduced into the rectum night and morning, administered every four hours alternately, tending more than anything else to keep up the powers of the patient. When all these means fail, or rather before—for it is known that life cannot be very long maintained under such circumstances—the question of opening the stomach by an operation must be entertained.

Billroth recently has cut down upon the œsophagus and excised the cancerous growth, but without success—the operation, however, is only commended to our consideration by the eminence of the surgeon who performed it.

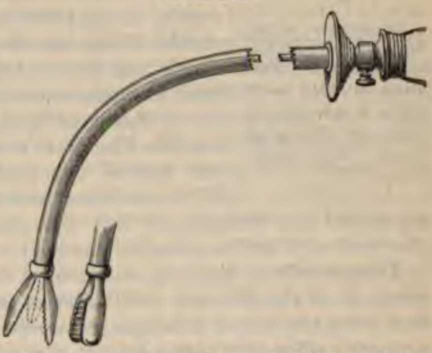
FOREIGN BODIES

are occasionally arrested in the pharynx, and, when pointed, may become fixed in the soft parts about the base of the tongue, or between the pillars of the fauces; but when bulky and solid, they are generally arrested at the narrowest portion of the tube, its lowest portion, behind the cricoid cartilage, or at the cardia. The discomfort caused by this accident is at times very great, and difficulty in swallowing, pain, and the disposition to vomit are common symptoms. A pricking sensation in the part is generally present when the substance is pointed, although it must be remembered that this symptom often remains after the substance has been dislodged. Where the epiglottis or upper orifice of the larynx is irritated, cough and other laryngeal symptoms will be produced, and the same may be said when a solid body becomes impacted behind the larynx; the larynx under these circumstances being either so compressed as to cause suffocation, or so irritated as to give rise to spasm, either of these causes being sufficient to produce death.

When small bodies lodge in the part, they may give rise to inflammation and abscesses in the pharynx and neck; indeed, instances are on record in which disease of the cervical vertebræ has been the result. Coins may be impacted in the pharynx for many months, and Dr. O. Ward relates a case ('Path. Trans.,' 1848–9) in which a halfpenny was so placed for eight months, the child at last, in a fit of coughing, bringing it up.

Treatment.—Whenever a foreign body, large or small, is suspected to have become lodged in the pharynx, a surgical exploration of the mouth, base of the tongue, and fauces should be made, and by carefully sweeping these parts with the index finger any foreign body will be detected. By this proceeding the foreign body may be dislodged. When any body is fixed in a part, it may be removed by forceps, the ordinary dressing forceps, as a rule, sufficing; when the body is lower down the revolving œsophageal forceps, as made for me by Mr. Krohne, of Duke Street, Manchester Square (Fig. 249), may be used. When a coin has been swallowed by a child, and become impacted in the pharynx, the child should be laid across a pillow upon his belly on a table, with the head hanging over the end, and supported. The surgeon should then introduce his finger into the mouth and depress the child's tongue, the coin by this manœuvre sliding out of its place.

Fig. 249.



Revolving pharyngeal forceps for the removal of foreign bodies, &c.

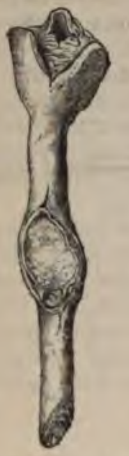
When a solid mass has become impacted in the lower part of the pharynx behind the cricoid cartilage and the finger cannot dislodge it, no forcible attempt should be made to push it down into the stomach, although laryngotomy may be called for to preserve life. If a second attempt to move the impacted body fail, it is well to desist, as by the lapse of time the spasm which existed when the first attempt failed may disappear, and a renewed effort may be crowned with success. Soft bodies likewise become softer, and consequently can be the better removed or pushed downwards. A good deal may, however, be done by digital manipulation, both inside and outside the mouth, either to dislodge the foreign body or to so alter its shape by squeezing as to enable it to pass downwards. The laryngoscopic mirror is often of great service in detecting the presence of a small impacted body, and in guiding the surgeon to its position. False teeth not unfrequently become dislodged and impacted in the pharynx. Paget has related such a case, where a man in a fit had one of his sets in the pharynx, where they remained four months. They were afterwards dislodged from between the base of the tongue and the epiglottis ('Med. Times,' 1862).

In 1864, when performing ovariotomy on a lady, under chloroform, alarming symptoms of suffocation set in, and on opening the mouth I found half a set of teeth had become dislodged and fallen into the pharynx. I have also heard of several similar cases. Before giving chloroform to old people the teeth always should be examined, and false sets removed. When such bodies become impacted, much care is needed in their extraction, and the utmost gentleness used.

Wounds of the pharynx, as a result of accident, are occasionally met with, falling with a sharp body in the mouth being the most frequent, and when they do not involve any large vessel, they generally do well. Durham relates a case of a boy, æt. 7, in 'Holmes's System of Surgery,' vol. ii, in which Mr. Johnson, of St. George's, had to ligature the carotid artery for repeated bleedings following a punctured wound of this part produced by the end of a parasol, in which an excellent recovery ensued.

Foreign bodies in the œsophagus are mostly arrested at the two narrowest portions of the tube—its origin behind the cricoid cartilage, or at its lower end just above the diaphragm—and anything that can be swallowed may be so impacted. The symptoms to which this accident gives rise are extremely uncertain. When the upper part of the tube is obstructed the laryngeal symptoms are generally alarming (Fig. 250), and when the obstruction is not complete, they may be very slight. Vomiting, however, under both circumstances, will probably take place to expel the obstructing body, and when this is severe, rupture of the œsophagus may ensue. This accident is to be suspected when, after severe and repeated straining the foreign body is ejected with violence, its ejection being attended with hemorrhage and followed by emphysema of the neck. An interesting paper on this subject may be referred to, by Dr. Fitz ('American Journal of Med. Science,' January, 1877). As a rule, however, besides the mechanical symptoms, the mere presence of a foreign body in the tube produces, secondary inflammatory symptoms may be set up, which may give rise to a fatal result. Thus, a case is on record, in which a fish bone perforated the heart and caused a fatal hemorrhage (Andrews, 'Lancet,' 1860); in another, where a sharp spiculum of bone caused ulceration on the third day into the aorta (Spry, 'Path. Trans.,' vol. iv, 1853); and in a third, where disease of the spinal cord ensued as a consequence of ulceration of the intervertebral substance, following the arrest of a piece of bone in the œsophagus (Ogle, J. W., 'Path. Trans.,' vol. iv, 1853). Erichsen also records a case in which a piece of gutta percha formed for itself a bed in the wall of the œsophagus for upwards of six months, and destroyed life by causing ulceration into a vessel and hemorrhage, and a second, in which a man died suddenly from hæmatemesis, the cause being discovered after death to be a half-crown impacted in the œsophagus, ulcerating into the aorta. Gairdner likewise gives a case where a fish bone passed through the posterior wall of the œsophagus and was found embedded in pus in front of the vertebral column ('Med.-Chir. Soc.,' Edinburgh, 1859), and my friend Dr. Sutton also has told me of an instance where a lunatic so plugged his pharynx with tow as to cause death by suffocation.

FIG. 250.

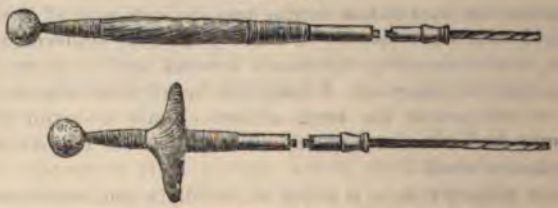


Preparation showing a piece of pudding impacted in œsophagus of a child, æt. 2 years, which caused death by laryngeal spasm. Guy's Hosp. Mus., 1793^{40}.

Diagnosis.—It is impossible for a surgeon under all circumstances to say with certainty as to the presence or absence of any foreign body in the œsophagus. When it can be felt by the finger or bougie, no doubt can be entertained; yet, on the other hand, when no such evidence is obtainable it may often be present, for a foreign body of small size may become so fixed in one side of the tube as to escape detection in the passage of an instrument. The best bougie for diagnostic purposes is one made of whalebone, with a smooth polished iron knob at its end, the one with a sponge at the end being useless.

TREATMENT.—When a foreign body is detected, the sooner it can be taken away the better. If the material be *soft* and *digestible*, it may be pushed downwards by means of an ordinary sponge or ivory probang or the tube of a stomach pump, care being taken not to use force, for such material will soften by the natural secretion of the part after the lapse of a few hours, and thus will be more readily pressed on. Should, however, the offending body be pointed, hard, or large, all idea of pushing it on must be dismissed, such a practice being most dangerous, although it has been done with impunity; a jagged plate with teeth having been pushed into the stomach and passed per anum. *Small pointed bodies* may be caught by the "horsehair" probang (Fig. 251), passed carefully beyond the position in which the foreign body is supposed to be placed, and then gently expanded, rotated, and withdrawn, the compression and rotation of the instrument causing the hair

FIG. 251.



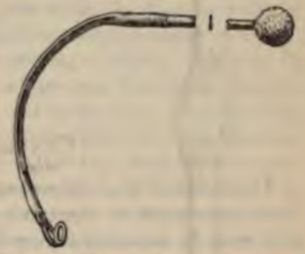
Horsehair probang expanded and unexpanded.

to spread out and to expand the œsophagus. *Sharp-pointed bodies* or *impacted hard irregular bodies* should, when possible, be removed by forceps. Those figured in No. 249 are the best, as they can be made to open when in the pharynx in all directions.

Vomiting will often cause the dislodgment of a foreign body, though at times it may render it more fixed. When vomiting cannot be produced by the administration of medicine, a solution of tartarized antimony, or of apomorphia gr. $\frac{1}{10}$, injected beneath the skin is said to act as well.

Coins and other flat but not pointed bodies can often be removed by means of the money probang (Fig. 252), the circular hook catching the coin and drawing it upwards.

FIG. 252.



Money probang, with sponge at one end.

Swallowing a large bolus of bread may carry downwards any fine bone or bristle, a draught of any liquid assisting the process.

Œsophagotomy has an established position in practical surgery, and the principles laid down many years ago by Arnott, are now generally accepted, viz., "where a solid substance, though only of moderate size and irregular shape, has become fixed at the commencement of the œsophagus, or low down in the pharynx, and has resisted a fair trial for its extraction or displacement, its removal should *at once* be effected by incision, although no urgent symptoms may be present" ('Med.-Chir. Trans.,' vol. xvii). Mr. Cock endorsed this opinion when he wrote in 1867 ('Guy's Rep.'): "The longer a foreign body is allowed to remain, unless we wait—a forlorn hope—for suppuration to loosen it, the more firmly it will become impacted. It would appear that success attends a speedy operation; whereas, where the use of the knife has been delayed until local inflammation, suppuration, or even sloughing has been established, the result of the operation has been fatal." Up to the end of 1877, 28 cases of this operation for the removal of foreign bodies have been recorded, and of these 23 were successful, the three last added to those given by Dr. David Cheever, of Boston, 1868, including two of Dr. Le Roy McLean, of Troy ('New York Med. Record,' 1877), and one of Mr. Wheeler's, of Dublin, 1875, and two of Langenbeck's ('Med. Record,' March, 1878).

More recently the œsophagus has been opened for stricture and cancer of the passage, and Dr. Menzel reports ('Wiener Med. Wochenschrift,' No. 56, 1870) two cases in which Billroth performed it. That which was successful occurred in a boy æt. 11, who seven years before had swallowed some potash lye. For two days before the operation neither liquid nor solid food could be swallowed, nor bougies passed. The œsophagus was opened and a cherry stone which had been fixed in the stricture removed. The boy drank water directly afterwards, and, in twenty-six days the wound had healed. The report does not say that he could swallow freely. The second case was for cancerous disease, but the man died.

The operation.—The patient should be placed in the recumbent position with his shoulders slightly elevation, the head being turned to the right or left side according to the point of projection of the foreign body. Where this guide is lost the left side should be selected, the œsophagus inclining rather to that side. An incision should then be made along the anterior border of the sterno-mastoid muscle, about four or five inches long, its centre corresponding to the position of the foreign body, and all the soft parts carefully divided. The omo-hyoid will then come into view, and underneath this, the carotid sheath with its vessels will be seen. The deep cervical fascia is then to be laid open, and if more room be required the sterno-hyoid and sterno-thyroid muscles may also be partially divided. The vessels with the sterno-mastoid muscle, should then be drawn well outwards by means of hooked retractors. The larynx with the œsophagus behind can then be examined, and the position of the foreign body accurately made out, pressure with the finger on the opposite side tending materially to make this point clear. Should the foreign body project, the larynx may be drawn well forward or towards the opposite side, and a cut made down upon the projecting part, the wound being carefully enlarged to allow of an extraction without force. When the foreign body does not project, a guide should be used, such as a silver catheter, flexible lead or tin sound, or a long pair of forceps introduced through the mouth downwards into the pharynx, the point of the instrument pressing forward the œsophageal wall. All vessels that bleed during the operation should be at once twisted or ligatured. On opening the œsophagus, the recurrent laryngeal nerve should be carefully avoided. The wound should be left open. The patient must be fed for a few days by means of a small œsophageal tube, introduced through the mouth into the œsophagus below the wound, care being taken during its introduction to keep the point against the opposite wall. Convalescence, as a rule, goes on steadily. I have been fortunate enough to see the operation successfully performed twice by my colleague, Mr. Cock, and the facility with which it was done has given me a very favorable opinion of its value. ('Guy's Rep.," 1858, 1867.)

CHAPTER XIV.

INJURIES OF THE ABDOMEN.

CONTUSIONS AND RUPTURE OF THE VISCERA.

INJURIES of the abdomen, like those of the cranium, derive their principal importance from the nature of the cavity's contents. The integuments and muscles forming its parietes may be severely injured and results follow which are simply of local importance; but when the peritoneal lining of the cavity is involved, or any of the viscera are injured, the case assumes a grave aspect. The presence of a wound is always an extra element of danger, and is to be measured by the extent and character of the visceral complication.

On the other hand the gravest internal abdominal injuries may coexist with the slightest external evidence of mischief.

Under certain conditions, a trifling blow on the abdomen may give rise to symptoms of an alarming nature, though a severe one is recovered from without exciting more than a fear. "The absence of shock immediately succeeding a severe lesion may lull suspicion, as its presence may by simple contusion excite alarm." Every abdominal injury, however trivial it may appear, must consequently be regarded with apprehension, and the utmost care observed in its treatment. This can be easily accounted for, Poland says ('Guy's Rep.,' 1858), "when we consider the numerous and vital structures contained in the abdomen: a serous membrane highly prone to inflammation; the 'peritoneum,' occupying an extensive amount of surface; a lengthy coil of organized tubing, 'the stomach and intestines'; solid substances, made up chiefly of bloodvessels, &c.; the liver, spleen, and kidneys readily lacerable and liable to rupture, causing nearly always fatal hemorrhage; receptacles for fluid, 'the gall and urine bladders,' which, under distension and force, may burst; large vessels coursing along the posterior wall, 'the aorta, vena cava,' &c.; and lastly, above all, the sympathetic nerves, consisting of the solar plexus and its numerous satellite plexuses and branches of such high organic importance, that injury or shock thereto may be attended with irreparable results. All these structures are, moreover, inclosed with soft elastic parietes, capable of great distension, which although readily able to resist shock and external violence without injury to themselves, yet may allow the force to be transmitted and expended on the contents with dire effect, and yet without leaving a trace or mark in the exterior."

In forming a diagnosis in this class of cases exclusion is the only sound method, every possible complication should be entertained and dismissed only when the weight of evidence is against it, the ultimate conclusion being founded as much on negative as on positive evidence.

"I am unacquainted," writes Le Gros Clark ('Surgical Diagnosis,' 1869), "with any diagnostic sign by which we may predicate whether shock following an abdominal injury exists primarily, apart from, or as expressive of actual breach of texture. Time alone can develop the true nature of the case, either by renewal of vigor or by the development of fresh symptoms." A severe internal injury may likewise exist without shock.

An injury to the abdomen from a blow, fall, or the passage of a wheel over the part may cause either a contusion of the abdominal wall more or less severe, with no visceral complication whatsoever; or a laceration or rupture of a viscus or vessel which will end in death without any (or very slight) external sign of mischief.

Pain as an immediate effect of injury is no indication of internal mischief, for in simple abdominal contusions it is at times very severe. When, however, it *lasts* or becomes *fixed*, it is a symptom of importance; and, when it *radiates* from a point, it is most characteristic.

Persistent vomiting is always a suspicious symptom of visceral injury.

Collapse, as a direct consequence of a blow, is of small value as a diagnostic sign, when of a passing nature; although when *persistent* or *relapsing* it indicates great mischief; as more or less complete collapse is a common effect of all abdominal injuries. A collapse, however, coming on at a distinct interval of time after an injury, as a rule means internal hemorrhage.

How far sudden death is attributable to a shock or collapse from a blow on the epigastrium or stomach without organic lesion is an open question, sound evidence being wanting to prove the fact. Dr. A. Taylor, in his 'Medical Jurisprudence,' adduces a case, that of Mr. Wood, in which a man, when fighting and intoxicated, suddenly died after the receipt of a left-handed blow on the pit of the stomach; but the evidence in the case as well as the facts revealed at the post-mortem were by no means conclusive as to the cause of death. The opinion has probably been accepted on the authority of Sir A. Cooper, who was in the habit of relating that as two men were working, one of whom was wheeling along a heavy load, his comrade thus addressed him: "That is too much for you; stand aside, and let me, a better man, take it." He accompanied these remarks with a slight blow on the scrobiculus cordis, and the man immediately let the barrow fall and died on the spot. After death no lesion was discovered. The case, however, had only been related to Sir A. Cooper, nor can a better be brought forward to support the theory. Under these circumstances, I concur with Mr. Pollock when he asserts, that he is somewhat sceptical on the point that death can occur without any organic mischief resulting from the blow at the time; that "sudden death attributable to a blow on the stomach or epigastrium must be a rare occurrence; and that medical men should be extremely guarded in ever offering an opinion as to the cause of death in such supposed injuries, without satisfying themselves, by most careful and minute post-mortem investigation, that no violence has been done to the viscera, either abdominal or thoracic." ('Holmes's Surgery,' vol. ii.) This question may, therefore, be summarily dismissed.

What then, it may be asked, are the usual consequences of an abdominal injury or contusion? and what are its risks and complications? The following facts will answer these queries.

At Guy's Hospital, during eight consecutive years, seventy-one cases of abdominal injuries were admitted. In *forty-four*, beyond a passing collapse, no serious or definite symptoms followed; tenderness over the injured part from the contusion was the most marked, but no evidence of any internal mischief showed itself. In these cases, rest in bed for a few days, with the local application of a warm fomentation, was the chief treatment, and in all, convalescence was rapidly established. In *ten cases* symptoms of *peritonitis* followed, as evidenced by excessive tenderness over the injured part, increased by movement, thoracic respiration—resulting from the indisposition of the abdominal muscles to act, and thus by pressure on the inflamed peritoneum to cause pain—nausea, and in some cases vomiting. Fever, and constitutional disturbance, varied according to the severity of the inflammation. In seven of these ten cases, *absolute rest* in the horizontal posture, local warm applications, either by means of fomentations or cataplasms, in some instances leeching, and *in all*, *opium* given in moderately full and repeated doses was the treatment adopted; and in every case, the inflammation was subdued before it had attained a dangerous degree of severity. In the remaining *three cases*, however, acute peritonitis set in, and in one terminated fatally. In *seventeen* cases, or about one-fourth of the whole number, rupture of the viscera took place. As a type of an ordinary case of peritonitis after injury, I adduce the following case:—

A man, æt. 22, received from a woman, while fighting, a blow on his right side, which was followed by syncope, but from which he soon recovered; no pain or inconvenience followed the injury for a week, and the man resumed his usual occupation. At this date severe abdominal pain appeared at the seat of injury, which rapidly increased and spread over the whole abdomen; vomiting also began, accompanied with considerable constitutional disturbance; and in this condition he was admitted into Guy's. He was put to bed, twenty leeches were at once applied and a grain of opium given, which was ordered to be repeated three or four times daily; perfect rest was also enjoined. In a few days these symptoms subsided, and he was enabled to take food without vomiting, pain ceased, and convalescence became gradually established.

REMARKS.—Such a case is interesting from the fact that some days elapsed between the receipt of the injury and the appearance of the peritoneal symptoms, as well as from the important practical point to be learnt from the rapid success that followed upon the treatment which was pursued. Rest, to its fullest extent, was doubtless the chief element of success—rest by position in the horizontal posture, and rest maintained by the administration of opium. It is not unfair to maintain that if this treatment had been adopted earlier, the symptoms exhibited would never have made their appearance; but the man following his occupation, the repair which was required after the injury could not be efficiently carried out, and, as a consequence, inflammation ensued. Of all cases abdominal injuries require absolute rest, and in no example, however apparently trivial, should it be neglected. If the mischief is but little, that little will more rapidly be repaired; if great, its evils and its consequences will be materially modified. The case already quoted indicates both points, viz., its primary necessity and its secondary good results.

It is thus seen that a blow upon the abdomen may be followed by a simple contusion of the abdominal wall, and, in exceptional cases, by peritonitis which may terminate fatally, although in the majority where such a result ensues, it is from rupture or lesion of some internal part. A local peritonitis, after an injury, is not, however, to be looked upon with displeasure, for, as pointed out by Mr. Hilton, the coagulable lymph which is poured out under these circumstances forms a temporary splint until the injured structures repair themselves. The inflammatory effusion producing a certain degree of rest to the injured structures, and thus contributing to the work of reparation.

What then are the symptoms of an internal abdominal lesion? How can the presence of such be made out? And what guides are there to the viscus that is wounded?

To answer these questions satisfactorily much space is needed, more, indeed, than can be well spared in this work; yet helps to diagnosis may be given, and among these, the nature and position of the injury are the best. Where the loins are the part involved, the kidneys are most likely to suffer; where the right hypochondriac region, and the ribs on that side are fractured, the liver is probably the organ that may be injured. On the left side, the stomach, or, more probably, the spleen; in the umbilical region, the intestines; in the pelvic region, the bladder.

Rupture of the liver usually destroys life by hemorrhage, and in the majority of cases within a few hours of the injury, in some, within a few days. Thus out of nine consecutive cases of ruptured liver, five died rapidly, three survived, three, seven, and nine days respectively.

There is little doubt, however, that recovery may take place when the fissure is limited and the case uncomplicated; when these occur they are classed with those of traumatic peritonitis; when they prove successful their true nature is not revealed. Preps. 1948—1951[5] in Guy's Hosp. Museum, with drawings, illustrate this truth.

When the laceration is *extensive*, death is always speedily produced by the shock and hemorrhage; coldness and general pallor of the whole body, with a feeble pulse, sighing respiration, and restlessness preceding the fatal issue. When the laceration is *less severe* life may be prolonged; and I have recorded in another work the case of a man æt. 45, who, when drunk, fell from a cart, and the wheel was said to have passed over his head. Intoxicated to an extreme degree, he was admitted under Mr. Birkett's care, into Guy's Hospital, presenting no evident symptoms of internal injury indicative of cranial mischief, beyond slight hemorrhage beneath the right conjunctiva. He was put to bed, soon fell asleep, and, on the following morning, with the exception of the hemorrhage into the orbit, *no signs* of mischief could be detected. Rest, however, in the horizontal position, was strictly enjoined; but to this he would not submit, and, thirty-six hours after the accident he got up, walked about, and with a sudden pain in his side, fell back, and died. After death, a fissured fracture passing across the right orbit was found without brain complication, and about a pint of blood in the peritoneal cavity which had evidently escaped from a severe laceration of the liver; a mass situated in the right lobe the size of a man's fist having been nearly separated. The right kidney was also fissured on its surface, and covered with coagulated blood. In this case the man clearly died from secondary hemorrhage, the result of the ruptured liver.

In rare instances the liver may be crushed partially, and, strange to say, its peritoneal covering be uninjured, yet in such cases life can be prolonged, and, when the mischief is not extensive, may be saved.

Fissures of the liver are usually met with on its upper surface, and a diseased organ is more liable to rupture than a healthy one.

The spleen is frequently injured, and such cases are by no means always fatal. Prep. 2018, Guy's Museum, illustrates its repair after injury. This organ, too, is sometimes lacerated by a fractured rib, or torn by a dragging of its surface. When fatal, the result occurs from hemorrhage.

Subdiaphragmatic abscess may occur as a consequence of abdominal injury, and the surgeon should suspect its presence in all cases where recovery is slow and attended with abdominal pain.

Rupture of the stomach generally proves fatal from shock alone, or irrecoverable collapse; the amount of distension of the organ, its contents, and the extent of laceration, influencing the result. When the rupture is large and effusion of its contents into the abdominal cavity takes place, acute peritonitis, with or without hemorrhage, will prove fatal, if the shock does not. When the rupture is small, and the stomach empty, there is some chance of recovery, local peritonitis subsequently gluing the injured part to the surrounding tissues.

When death is not immediate, the patient will complain of an acute and constant pain radiating from the seat of injury, so peculiar indeed that "the intensity of it absorbs the whole mind of the patient, who, within an hour from the enjoyment of perfect health, expresses his serious and decided conviction that if the pain be not speedily alleviated he must die." Vomiting is a constant symptom, first of the contents of the stomach, and afterwards of blood; collapse, rigors, and syncope are often met with.

Incomplete rupture of the coats of the stomach is found sometimes after death, and, in Guy's Museum (Prep. 1817^{25}) there is the stomach of a child æt. 7, in which, from a sudden blow upon the distended viscus, the mucous membrane was detached and lacerated in a remarkable manner.

Rupture of the intestines, both large and small, is a somewhat common form of abdominal injury, and may be produced by a fall, a blow, the passage of a wheel over the abdomen, or even violent muscular exertion. Hennen ('Military Surgery') gives a case where a soldier received a contusion of the abdomen, and sloughing of the integument followed with artificial anus, yet in six months the feces resumed their natural course and a recovery took place. In Guy's Museum there is a specimen (Prep. 1851^{85}) of perforation of the small intestines of a man who had received a kick from a horse and died thirteen days after the accident with extensive peritonitis, from fecal effusion. Prep. 1851^{86} consists of a portion of jejunum, taken from a man who had been kicked in the abdomen, the injury being quickly followed by symptoms of extravasation and death in forty-eight hours; Prep. 1850^{88} was taken from a case of perforation of small intestine from the kick of a horse, terminating in death in twenty-four hours; No. 1851^{89} is a portion of jejunum in which are two openings through which the mucuous membrane is inverted and resulting from a kick in the abdomen; No. 1851^{91} is an example of laceration of the jejunum in which the bowel is completely divided. It was taken from a man æt. 37, who had been run over by a cart, and lived twenty-four hours. Lastly, the specimen marked 1851^{87} is from a case that occurred in the practice of my father, the late Mr. T. E. Bryant of Kennington, and is a portion of ileum in the coats of which there is a small perforation, the injury being produced by running against a post, and followed by collapse, from which the patient did not recover, but died on the third day.

Cases are also on record in which, after an injury, a portion of intestine has sloughed and subsequently passed per rectum, a recovery taking place. In the Anatomical Museum of the University of Edinburgh several such preparations exist.

The duodenum is rarely ruptured, its position protecting it; nevertheless such an accident does occur. Taylor, in his 'Medical Jurisprudence,' gives a case, where a boy æt. 13, after a blow on the abdomen, walked a mile with but little assistance, and, when he died (thirteen hours after the accident), the duodenum was found to be completely ruptured across.

The jejunum is doubtless more frequently ruptured than any other part of the intestines, its fixed position rendering it liable to be torn away from the duodenum by such an injury as the passage of a wheel over the abdomen. Poland gives fourteen examples of this kind, and in half of these the laceration was at its upper part. In one case, after death, three or four pints of thin pink-colored fluid was found in the abdomen, probably the iced water of which he had freely partaken after the accident, and in all, death took place from collapse and peritonitis.

The ileum is also frequently ruptured, and most commonly from a direct blow or fall on a hard body. In the majority of such cases there is no external mark of injury, and fecal effusion with peritonitis are the usual causes of death. When the rupture is large, little hope exists of a recovery; when small, such a hope, however, may be entertained.

When a patient is the *subject of hernia* and receives a blow upon the tumor, a ruptured intestine may doubtless take place. Aston Key made this the subject of a memoir in the

'Guy's Reps.' for 1842, and Poland has collected many such cases in the same periodical for 1858. Rupture of the gut is the usual result of such an accident, and when it occurs, a fatal termination is to be expected. When the bowel is only bruised, however, it may recover or slough, and be followed by an artificial anus.

In none of these cases should any attempt at reduction be made, when symptoms of inflammation or of injury are severe. The surgeon should, however, explore the sac. In all recorded cases where the bowel was returned, a fatal result took place.

The large intestine is rarely ruptured from violence. When over-distended from fecal accumulation the result of stricture or otherwise, such a result may ensue; but, under ordinary circumstances, it is too well protected. I have, however, known florid blood to flow from the bowel after an abdominal contusion, and have, from that fact, suspected some laceration of the colon.

TREATMENT.—The chief point to insist on is the absolute necessity of treating *every case* of injury to the abdomen with excessive caution, as very severe mischief may be caused by violence and yet the immediate symptoms not be marked. Collapse after the injury, as has been shown, is by no means a necessary consequence; for rupture of the intestine itself may take place without exciting such a condition; indeed, a patient may walk after a ruptured liver or intestine. The surgeon, therefore, should be guarded in his prognosis as well as careful, watchful, and expectant in treatment.

In every case absolute rest should be secured and maintained. If the injury be slight, convalescence will soon be established by such treatment; if severe, secondary bad results may be prevented, and, at any rate, be relieved. No case of abdominal injury can be pronounced well within a fortnight.

If local tenderness exists, fomentations or cataplasms should be used; and if it amounts to pain, leeches in large numbers (twenty or thirty) must be applied. In some cases, however, the application of ice gives more relief. Opium should always be given in small and repeated doses, as it allays pain, assists wonderfully in maintaining rest to the injured peritoneum and viscera, and tends materially to arrest inflammatory action.

The patient should be kept free from all excitement, and as little nourishment administered by the mouth as will suffice to sustain life; if the intestines are believed to have been ruptured, *starvation* treatment must be carried out. Whatever is given should be liquid and cold. Milk and ice is the best and simplest combination, and upon this life can be sustained without difficulty. If great thirst exists, ice may be given; but this must be administered with caution, as the case already quoted well illustrates. When the intestine is believed to be injured, the allowance of fluid must be very scanty, the patient's powers being kept alive by enemata of beef-tea administered in small quantities, say three or four ounces repeated at short intervals.

On no account ought a purgative to be administered. This rule is golden in these cases, and should never be deviated from; as by infringing it in a careless moment, the whole of nature's processes in repairing the injury may be undone, and irreparable mischief follow. Constipation is the sign of a passive condition of bowel to the preservation of which all our treatment is directed, a purgative being merely an irritant, and in its effects absolutely destructive.

In all cases the prognosis and treatment should be most guarded, cautious, and expectant; and, in all, the *state of the bladder* should be well attended to, for retention of urine from disturbed nerve influence is a common accompaniment and must not be overlooked.

Rupture of the kidney is an accident from which recovery is more common than from any other viscus. Its position in the loins outside the peritoneal cavity, being doubtless a sufficient explanation of this fact; indeed, when not very severe and uncomplicated with other injuries, such cases usually do well. It is generally known by an attack of hæmaturia and local pain following a blow on the lumbar region. The hæmaturia may be but slight and passing, or not show itself till the second day. It may cease also after the lapse of two or three days, when it is probable that only a contusion of the kidney had taken place, for in more severe injuries the bleeding may last fifteen days or even more. At times clots will be passed, assuming the shape of the ureter, and I have before me the notes of some half dozen cases in which these symptoms were present, and from which recovery took place. These clots, however, at times give rise to retention of urine by blocking up the urethra. Retraction of the testicle is an occasional symptom, and so is pain in the course of the ureter.

The treatment to be pursued in these cases is, rest in bed and milk diet. In some cases where the bleeding is profuse, a grain of the acetate of lead may be given with half a grain of opium three times a day, or gallic acid in ten-grain doses. The tincture of ergot in full doses is also a valuable drug under similar circumstances. Opium, however, should be given with caution.

When the organ is crushed, the injury is likely to complicated with other mischief, and, under such circumstances, peritonitis and hemorrhage, singly or combined, generally prove fatal. When the organ is single and becomes injured, a fatal result is also likely to occur. In page 125 of my "Clinical Surgery" I have recorded such a case.

When peritonitis exists, opium is of great value; where urinary abscess in the loins follows, as it occasionally does, particularly in gunshot wounds, the surgeon must make a free incision into it on the outer border of the quadratus lumborum muscle.

Rupture of the ureter was first noticed by Stanley in the 'Med.-Chir. Trans.,' vol. xxvii, and in the two cases he related, a fluctuating tumor formed by the effusion of urine existed in both. Poland, in the 'Guy's Rep.' for 1868, has recorded a third case; but beyond these no others are on record. Four cases of wounded ureter are, however, published by Hennen ('Mil. Surg.'). In all these cases it seems the ureter was ruptured by stretching, its renal end having suffered; and I have seen two of these which occurred in the practice of my colleague Mr. Howse.

The symptoms are very obscure, particularly where no external wound exists; indeed, there are none to indicate the nature of the accident in its early stage. At a later period a lumbar tumor may appear of a cystic nature caused by the retention of the secreted urine, and there may be more or less peritonitis. When a lumbar swelling exists, tapping the cavity should be performed, the operation being repeated from time to time as the fluid re-collects, the kidney in time probably ceasing to secrete. When this treatment fails, there is little doubt that a free opening into it in the loin is the correct treatment. Under other circumstances, the case must be treated as all others of abdominal injury, by rest and opium.

Mr. Holmes records in the 'Med.-Chir. Trans.' for 1877, vol. xlii, an interesting case of wound of the ureter which occurred in a boy æt. 13, where a clasp knife had entered his body from behind, upwards and outwards just on the right of the middle line, and about on the level of the posterior superior spine of the ilium. The wound discharged urine for two weeks and then closed, the boy recovering.

Rupture of the gall-bladder has been recorded as the result of accident, and when it occurs, death is usually rapid. The accident is marked by extreme collapse and pain in the seat of injury. Poland, in his 'Fothergillian Prize Essay,' has given us such a case, and Dr. Fergus, in the 'Med.-Chir. Trans.,' vol. xxxi, has recorded another. In one the death occurred from collapse, and in the other from peritonitis.

Rupture of the hepatic duct may also occur. In Poland's Fothergillian Essay such an instance is recorded, and occurred in a boy as the result of a blow on the abdomen, the accident being quickly fatal. My friend Dr. Sutton has kindly given me the details of a second case, which took place in the London Hospital in 1867. It was in that of a man, æt. 29, who was knocked down, and the wheel of spring dray passed over his stomach. He felt pain in the right hypochondriac region directly, and "had hard work to get his breath." Abdominal pain increased and jaundice appeared, and for a month he kept his bed. On the thirtieth day after the accident, as he did not improve, he was admitted into the London Hospital, under Drs. Herbert Davies and Sutton. Then he had abdominal pain, tenderness, and distension. There was distinct ascitic fluctuation over the abdomen, and deep jaundice. He sank eight days after his admission, and thirty-eight days after the accident. The autopsy revealed the fact that the hepatic duct was torn across a quarter of an inch above the spot where the cystic joins the common duct; no other part of the liver was injured. The abdominal cavity contained quarts of olive-green bile-stained fluid, and the peritoneum was covered with yellow matter of the color and consistence of paint, which was found to be inspissated bile.

Rupture of the urinary bladder without fracture of the pelvis is also to be met with as the result of some abdominal injury, and, when it occurs, is usually due to external violence applied to a distended organ. As a rule the rupture takes place at its posterior wall, the urine escaping into the peritoneal cavity, and rapidly causing death. In exceptional cases it affects the anterior wall, when the urine infiltrates the cellular tissue of the pelvis. Birkett tells us ('Holmes's Surgery,' vol. ii) that, with three exceptions, all the cases recorded, terminated fatally. In one only of these three was the peritoneum involved (Chaldecott's case, 'Prov. Med. Surg. Journ.,' 1846), in the other two the extravasation was into the pelvic connective tissue. Dr. Stephen Smith, of New York, in an able monograph, 1851, reports five cases of recovery out of seventy-eight, these figures not including one of Birkett's (Porter's case), consequently the recoveries reported amount to six.

The symptoms of the injury are mostly collapse, preceded by severe abdominal pain and ineffectual attempts to micturate. When life be prolonged peritonitis more or less acute will appear. Dr. Smith reports three cases in which the inability to urinate continued, and twelve in which it returned on the second or a later day.

Rupture of the bladder with fracture of the pelvis likewise occurs.

If the surgeon be induced to pass a catheter from the ineffectual efforts of the patient to pass urine, it will often happen, that no success will be achieved, but in some cases, a vast amount of fluid will be withdrawn, the catheter under these circumstances having doubtless been passd through the rent in the posterior wall of the organ into the peritoneal cavity. I have known a case where several pints of fluid were drawn off under these circumstances.

TREATMENT.—When any time exists for treatment, the indications are, *to allow of a free exit for the urine as soon as secreted*, and, to check peritonitis. A certain amount of peritonitis must be looked upon as beneficial, as it tends towards the first indication of treatment, the prevention of extravasation, but any excess of action requires prompt treatment. Opium is without doubt the best drug to promote this end, a full dose of the solid or the tincture being given, and followed up to maintain its action; absolute rest, local fomentations, and possibly leeches are valuable adjuncts. As little food should be given as is absolutely necessary to maintain life, and ice in moderation to allay thirst. The bladder should be kept empty, the maintenance of a large catheter in the viscus, with an opening in the end, being the best method, according to Birkett; though it seems probable that a free incision through the perineum into the organ, as in lithotomy, is the better practice, as it is when the bladder is ruptured from a fracture of the pelvis.

Injury to the uterus, when large from pregnancy, deserves a passing notice, for such cases are serious. A contused organ may inflame, and be followed by absorption or miscarriage, or should pregnancy continue, its structure may be so altered as to be liable to rupture. I have known also an intra-uterine fracture of a child's thigh to take place as a consequence of a fall. In obstetric works cases are recorded in which a distinct rupture of the organ followed.

Rupture of an ovarian cyst from a blow is also recorded, and, under certain circumstances a good result may take place; all obstetricians have met with such cases. As a rule, however, a fatal peritonitis follows.

Rupture of the diaphragm is an accident that occurs in practice, but difficult to diagnose. It is generally the consequence of some violent injury, such as a crush, or the passage of a heavy wheel over the waist. In such cases the injury is complicated, and usually with hernia of the abdominal contents into the thorax. This injury can only occur on the left side. Dr. Wilks, in the 'Lancet' for 1858, reported three instances of this diaphragmatic hernia, and pointed out that *excessive thirst* was the most prominent symptom in each. I had the opportunity of seeing these three cases, and others since have come under notice, and this symptom of thirst seemed to be most characteristic; thirst insatiable. In January, 1872, a case of this kind came under my care with this symptom well marked.

WOUNDS OF THE ABDOMEN, INVOLVING PARIETES AND VISCERA.

The parietes of the abdomen are often wounded by sharp substances, whether by accident or design, and so long as the wounds are confined to the parietes the danger is small. When the peritoneum is punctured or perforated, the viscera are also probably involved, and, under such circumstances, the case becomes serious. In rarer instances the intestines protrude, when an additional element of danger is added.

Wounds of the parietes alone require the same treatment as wounds of any other part. The surface should be well cleansed, and all foreign bodies removed. Hemorrhage should be arrested by torsion or ligature, and the edges of the wound brought together with sutures. In deep or lacerated wounds, where the risk of suppuration between the muscles or fascia is great, absolute rest in the horizontal position should be enjoined, the muscles being thus relaxed. When suppuration appears, the surgeon must be careful to let out all fluid either by reopening the wound, or, by a fresh opening. In all wounds of the parietes, the surgeon should be particularly careful to arrest bleeding at once, and to let out anything like pus as early as possible. *All punctured wounds should* *be left open;* when bleeding persists, the wound should be enlarged and the vessel secured.

Penetrating wounds of the parietes.—There is always a difficulty in diagnosing these cases; that is, in making out the true nature of the accident, more particularly in punctured wounds. When the depth of the wound is known by the extent of insertion of the offending body and the relative position of the viscera at the wounded spot also, some notion as to its nature may be formed; but when no such guide can be found, the surgeon has to rest upon other evidences such as surmise and probabilities. As a rule, where want of evidence is felt, it is well to treat the case as serious. All penetrating wounds are serious, whether incised, lacerated, punctured, or gunshot, but punctured wounds are by far the most common.

When the viscera are *uninjured*, there will be a total absence of all other symptoms beyond the parietal wound, *and these negative symptoms afford the best positive evidence of the simple nature of the accident.* When the viscera are *injured*, there will generally be more or less lasting syncope, or collapse; there will probably be severe local pain, soon becoming radiating; there will also frequently be vomiting, possibly of blood, or the passing of blood from the bowel or bladder. If life is prolonged there will be peritonitis. When the bowel or omentum protrudes, when the fæces, bile, urine or blood appear at the wound, the evidence is clear. The surgeon, however, will find much help from collateral evidence in forming an opinion; as, the size of the wound compared with the instrument that inflicted it; the position of the blood stain on the instrument; the force with which the blow was struck; the direction of the force in relation to the position of the patient; and the thickness of the abdominal parietes. By all these means an approximate opinion may be formed, but in no case can a positive diagnosis be made with certainty. Under all circumstances, however, the *treatment* must be the same.

Rest.—Absolute rest being an essential point, no movement should be allowed, not even for passing the evacuations. *Opium* in moderate or full doses, according to circumstances, is also demanded, it being well to keep a patient under its influence for several days, by giving one grain every four or six hours. *Low* diet, that is, milk diet, should be allowed, all food being given cold and in small quantities; ice to suck is refreshing. *Purgatives* should on no account be given till the nature of the case is declared. With respect to *local treatment*, the greatest simplicity should be employed. The wound should be cleansed, and all bleeding vessels secured, but anything like an exploration of the wound is to be condemned. All probing, fingering, or manipulating the wound should be avoided as dangerous and only pertaining to surgical curiosity.

The abdominal muscles should always be relaxed by position, and the edges of the wound, when it is large, brought together by sutures. Water dressings should then be applied. Punctured wounds when perforating, like others, should be left open. Even after the lapse of some days, when no symptoms of wounded viscera appear, the same caution should be observed, two or three weeks being always allowed before freedom is given. Under all circumstances the condition of the *bladder* should be inquired into.

Penetrating Wounds, with Protruding Viscera.

It is hardly necessary to remark that the special risk of any of these cases is determined greatly by the viscus that is involved, and the amount of injury it has sustained. Thus, a penetrating abdominal wound with protruding omentus is far less dangerous than when hernia of the intestine exists, and a protruding wounded bowel is of graver importance than an uninjured one. It is consequently necessary for the surgeon in all these cases mentally to run over the position of the viscera, in order that he may form an opinion as to the probabilities of the case. Fig. 253 will refresh his memory on these points.

"Of the hollow viscera any portion of the intestinal canal may be protruded, from the stomach to the sigmoid flexure, according to the situation and degree of distension of the viscera. The small intestines most frequently, next the large, then the stomach, and, lastly, the cæcum. Of the solid viscera the omentum is by far the most common, and is often associated with that of the viscera." (Poland's 'Prize Essay.')

In *small* wounds a limited hernia of the abdominal contents can alone take place, but when it occurs, the protruded viscus is very liable to be strangulated. In *large* wounds the hernia will probably be of greater extent, but their constriction is rare.

When omentum protrudes through a recent wound and is uninjured, it should be washed by means of a stream of water squeezed over it from a sponge or emitted from a syringe, and returned with all gentleness, the patient being placed in such a position as to relax the injured muscles. The wound should never be enlarged to allow of the return of the omentum. When the omentum has been extruding for some time, and is congested from incarceration or strangulation, when it has become inflamed or perhaps sloughing, it is well to leave the mass alone, at least, it is not wise to make any attempt at its reduction. As time goes on and the projecting mass swells and granulates, it may be well to ligature the whole in halves. This should not be done, however, for at least two weeks after its protrusion. During this time the greatest quiet should be enforced, and moderate doses of opium given with liquid food. After a few days, all fear of peritonitis will have passed. Some prefer not to interfere with the protrusion, in the belief that it will wither up sooner or later, but such a process is tedious, and the application of a ligature to it, moreover, in halves is rarely attended with any risk. If the omentum is much bruised or torn at the time of injury, such injured portions may be cut off and all divided vessels secured.

FIG. 253.

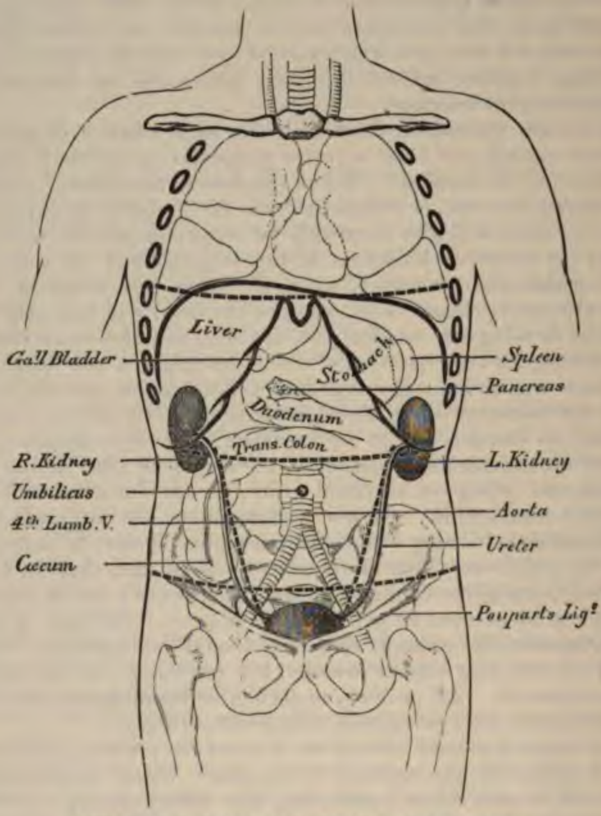


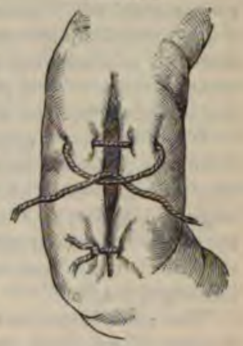
Diagram showing the positions of the abdominal viscera.

When the bowel protrudes through the wound and is *uninjured* it should be cleansed and *returned under all circumstances*, the wound being carefully enlarged in the course of the muscular fibres for the purpose, should its reduction be otherwise impossible. To facilitate this, the muscle should be relaxed, and the parts last descended returned first. In returning the intestine the pressure should be directly backwards; if made obliquely, the bowel may be pushed up beneath the fascia or muscles, and thus outside the peritoneum. The wound should be closed by sutures and treated as already described.

When the protruded bowel is *gangrenous*, it must be left *in sitû* to slough and that an artificial anus may form, the wound in the abdominal parietes being enlarged; but where there is a prospect of its recovery, the abdominal cavity is its best place.

When the intestine is wounded and the opening a mere prick, through which no intestinal contents exude, the bowel may be returned, a few hours being enough for the wounded part to become sealed by plastic exudation and repair to be completed. When the mucous lining protrudes, the opening should be tied by a single ligature. When the wound is sufficiently *large to permit of the escape of the visceral contents*, it must be stitched up with one of the forms of suture seen in Fig. 35 or 254, cleaned and returned, the ends of the sutures being cut off close.

FIG. 254.



Illustrating one form of application of suture to the intestine. The thread is made thick for the sake of clearness.

For another, *vide* Fig. 35, p. 119.

When the wound *involves nearly the whole calibre of the bowel*, it is wiser to stitch the edges of the bowel to those of the wound, thereby making an artificial anus, than to stitch the two divided ends of the intestine together, and to return the whole into the abdominal cavity. Pollock ('Holmes's Surgery,' vol. ii) says, however, if the division be caused by a clean sharp instrument, the extremities may be brought together with sutures and returned; but if the separation be the result of an irregular lacerated wound, as from gunshot, &c., we should not hesitate to fix the edges to the external wound, and risk the chance of an artificial anus. When the bowel is stitched to the edges of the external wound care should be taken to maintain the line of the canal as much as possible and not to draw the intestine more out of its position than is absolutely necessary.

The general and local treatment of all these cases is similar to that already laid down for the treatment of other abdominal and visceral injuries.

Penetrating abdominal wounds complicated with wounds of the viscera, but without protrusion, are, doubtless, far more serious than any that have been hitherto considered, and their effects depend greatly on the condition of the viscus when wounded. Thus the puncture of a *distended* stomach, intestine, or bladder, will to a certainty be followed by extravasation into the abdominal cavity, and, as a result, by great shock and diffuse peritonitis; whereas these organs, when empty, and therefore contracted, may receive a limited injury without any such consequences taking place, *local* inflammation rapidly arising under these circumstances and sealing the wound.

Nevertheless, remarkable cases of recovery after impalement are on record, and not the least is that of a boy, æt. 11, who fell upon a rick-stake, the stake penetrating his body for seventeen and a half inches. It entered the abdominal cavity in the *right* groin, beneath Poupart's ligament, passed through it to the left side into the thorax, through the diaphragm—displacing the heart and pushing it to the right side of the sternum—into the left lung and passed out of the chest between the seventh and eighth ribs into the axillary space. The stake was removed four hours after its introduction, and not a teaspoonful of blood was lost. Some intestine which protruded from the wound in the groin was replaced, and the inguinal wound stitched up. Opium, with calomel, was freely given subsequently, and in six weeks the boy was able to sit up, play, and eat his ordinary food. Five months after the accident he was free from pain, and able to walk freely. The case occurred in the practice of Mr. Reynolds, of Thame, Oxon, and is recorded in the 'Med. Times and Gaz.,' Sept. 23, 1871. The chief risks of wounds of the viscera when the solid organs become implicated are hemorrhage, and when the hollow, extravasation. When the contents of the wounded organ escape externally through the wound, the danger of the case is undoubtedly lessened. When the *stomach* is supposed to be wounded by a puncture the utmost care is called for to prevent the administration of any food; indeed, *nothing* should enter the stomach for several days, and life should be maintained by nutrient enemata, because to excite any action of the organ would undo what nature may have done for the repair of the injury, and thus jeopardize life by increasing the risk of extravasation.

When the *intestine* is *wounded* or suspected to have been wounded, the same care is necessary, although ice or iced milk in limited quantities, may be allowed to satisfy thirst.

Opium, of course, should be given, and is best administered by suppositories—the morphia suppositories of the Pharmacopœia being the best preparation to employ in all cases of abdominal surgery. The principles of treatment, however, are the same as have been laid down in former pages. In all penetrating wounds of the abdomen in which any evidence of wounded viscera exists, the *local wound should be left open*, or covered only with a loose covering; for to close the wound so as to prevent the escape of the contents of the wounded viscus externally, would be to close the only gate through which return to health is possible.

Abnormal Anus, Fecal Fistula.

Confining the term "*artificial anus*" to the surgical operation of forming an anus otherwise than natural for the relief of intestinal obstruction, whether by colotomy or enterotomy, an "*abnormal anus*," or intestinal fistula—*fecal fistula*—or an unnatural communication between the intestinal canal and the outside of the body, is generally the result of a sloughing or ulcerating bowel in strangulated hernia; although it may occur, either from a wound of the intestine from some external cause, or, from a perforation of the intestine from an ulcerating process originating from within.

When it follows a hernia, the opening is usually at the neck of the hernial sac; when it follows a wound, at the seat of injury; when it is the result of some ulcerative process originating from within, the fecal abscess may burrow into the pelvis (opening into the vagina, bladder, or even bowel again), or between the abdominal muscles, and makes its appearance in the groin, iliac fossa, or loin. When the opening is *large* and *direct* into the bowel it has been called "artificial anus;" when small, indirect, or fistulous, "fecal or intestinal fistula."

The most important point, however, connected with this subject has reference to the amount of intestine involved. When only a small portion of its calibre has been lost, the fistula generally will be small; when a large portion of its calibre or a whole knuckle has been involved, the fecal orifice will be large. Under these circumstances the two orifices communicating with the upper and lower ends of the bowel respectively can generally be made out, a fold of membrane formed by the junction of the bent tube standing as a partition between the two portions of the gut. At times, this partition will project so far forward as to close completely the orifice of the lower part of the bowel, and this is the usual state of affairs when a complete knuckle of bowel has been involved in the disease, and under these circumstances a cure by natural processes is almost impossible. At other times the partition will be but limited, and a portion only of the contents of the bowel will pass externally, the other portion taking its normal course downwards towards the anus, when it is more than probable that nature alone, or but slightly assisted by art, will effect a cure. When the orifice is large, there is almost always some prolapse of the bowel. Under all these conditions, the intestines within the abdomen are closely connected by means of adhesions to the external orifice; the serous surface of the intestine becoming firmly fixed to that of the opening in the abdominal parietes. Beyond these adhesions it is rare to find other coils of intestine adherent about the part; on the contrary, the parts are otherwise usually so free that coils of bowel will be found separating the two portions of intestine that are adherent at the wound, and may so dip down between them as to push forward a serous sac into the artificial opening, and even to form a hernia. The nature of the discharging fluid will fairly indicate the portion of the bowel involved: when well-formed feces pass, the large or lower part of the small intestine is probably the seat; when the fluid is thin and inoffensive, the jejunum is indicated. The yellow semifeculent contents of the ileum can generally be recognized. The nearer the opening is to the stomach the worse is the prognosis, as nutrition under such circumstances must be seriously interfered with. The nearer it is to the lower end of the canal, the better are the prospects of life.

Treatment.—When the orifice is fistulous and the canal below the fistula is fairly open for the passage of feces, a cure may with some certainty be looked for by natural processes, and such a result is by no means unusual in the artificial anus, which is met with, *after the return of a small hernia into the abdomen*, and particularly of a femoral. In these cases the surgeon has little more to do than to keep up the strength—giving simple nutritious diet, maintaining perfect cleanliness of the wound, and applying gentle pressure to the part. When the fistulous communication is larger, the same treatment must be employed, though with less hope of success. Lawrence recommended the constant use of a truss in these cases to prevent prolapsus, and Pollock strongly advocates the importance of the recommendation, adding, that "a compress of linen placed on the opening, with a larger pad over it, and a truss applied over the whole, will, in a great measure, restrain the contents as well as prevent the protrusion of the bowel." To assist the contraction of small fistulæ, the edges may be cauterized or even pared, a plastic operation being justifiable under certain circumstances.

With respect to surgical interference in these cases, the recommendations I have to offer are not very satisfactory. Dupuytren suggested an operation to get rid of the projecting fold or septum that has been described. He did this by an instrument called an enterotome, a pair of forceps with one blade grooved, into which the other closed, the approximation of the blades being regulated by a screw. The septum was crushed between the blades and so held till its destruction was effected. The instrument, as a rule, came away about the seventh day, and, Dupuytren says, "by the division and loss of substance, the ridge and the double septum which separate the two ends of the bowel are destroyed so as to re-establish the interrupted communication between them, and restore the natural course of the aliment and feces." Jobert advises the pressure of the instrument to be gradual, fatal cases having occurred when Dupuytren's rapid process has been employed. The theory of this operation is good; and is based on nature's own processes; for I have seen the septum of an artificial anus ulcerated through, by natural processes, leaving an opening through which feces passed from the upper to the lower bowel, a narrow band above, alone existing to prevent freer feculent flow. The success of the operation has also been good; inasmuch as out of forty-one operations recorded by Dupuytren, twenty-nine recovered, nine were relieved, and three died. In this country, the operation has been little practised. Dr. Buchanan, of Glasgow, however, has recorded a successful case. ('Edin. Med. Jour.,' 1869.)

When a *fecal abscess* has formed in the abdominal walls, the sooner it is opened the better, and, when opened, the incision should be free. In abscesses connected with the *cæcum* or its *appendage*, this rule is important, and, if acted upon, good results may be anticipated. For intestinal fistula opening directly into the *vagina* little can be done surgically beyond attending to the general condition of the patient, giving nutritious food, though not such as is likely to distend the bowel, and observing perfect cleanliness of the passage. The external opening should be enlarged, however, if anything like retained pus exist. Under these circumstances, a natural recovery may take place. In recto-vaginal fistulæ, plastic operations are most successful.

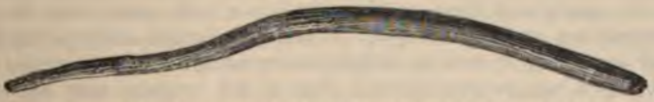
When the *bowel* has ulcerated into the bladder, natural processes appear to be rarely capable of effecting a cure, and, under such circumstances, to save the patient from the miseries caused by the passage of solid feces into the bladder, the operation of colotomy may be entertained. I have performed this operation on four occasions under these circumstances with success, the operation in all giving great relief. One of my patients is now (1878) alive, free from all pain, the operation having been performed on July 5th, 1870 ('Clin. Soc.,' 1872). In another case operated upon in August 16th, 1869, the gentleman lived to March, 1875, and died from heart disease at the age of 70. The third died from some kidney affection some months after the operation ('Med. Chir. Rev.,' 1869). The fourth died some weeks after, from the cancerous affection for which the operation was demanded, but free from all pain.

FOREIGN BODIES IN THE STOMACH AND INTESTINES.

Foreign bodies are often taken into the stomach from accident and design, and the records of cases prove that from the absence or mildness of symptoms, no surgeon should pronounce against the possibility of their introduction. They are passed as often as not per anum without giving rise to very distressing symptoms; although when retained they cause nothing but evil. *Smooth hard bodies* such as coins and stones, as a rule, pass readily without giving rise to any or other than slight colicky symptoms, but *sharp* and *pointed bodies*, such as bones, pins, knives, &c., give rise to such as vary according to the position of the intestines at which they become impacted.

A foreign body taken into the stomach may be ejected by vomiting, discharged externally through the abdominal parietes, retained in the stomach, or passed onwards. In Fig. 255 is illustrated a piece of iron wire that was swallowed by a female lunatic, æt. 56,

FIG. 255.



Piece of iron wire discharged from abscess in abdominal walls after having been swallowed. Natural size.

on March 10th, 1873. The symptoms that followed were so slight, that some doubts as to the occurrence existed, and it was not till May 15th, two months later, when a swelling was detected in the right of the umbilicus, that the history was credited. The swelling rapidly increased and opened on May 20th, and the point of the iron wire projected. This was withdrawn by Dr. T. B. Dyer, the surgeon of Colney Hatch, and a rapid recovery followed, no single bad symptom making its appearance. My friend Mr. Lund, of Manchester, has likewise recorded a similar case in the 'Liverpool and Manchester Med. Surg. Reports' for 1873. When retained, a foreign body may rest without giving rise to very serious symptoms—a rare result—or set up ulceration which may in its turn give rise to a fatal peritonitis. In the more fortunate, it will be passed on through the canal and discharged.

To prove these points, the reader may refer to Mr. Pollock's article in 'Holmes's System,' vol. ii, where he gives a case in which a lady vomited a gold plate three-quarters of an inch long, with two false teeth, after it had been lodged in the œsophagus for nineteen and in the stomach for ninety-seven days. Another case, that of Mr. Taylor's of Edinburgh, in which a patient *passed per anum*, three days after swallowing it, an artificial plate with six teeth an inch and three-quarters long. And a third is on record in which a lady passed per anum, six months after she had swallowed it, a plate two and a quarter inches in diameter with four teeth.

A remarkable case of this kind has been recently recorded in the Thirtieth Report of the Commissioners in Lunacy, 1876. A woman æt. 43 (having made previously many suicidal attempts), on July 31st, 1875, swallowed thirteen screws, each screw consisting of a body 2½ inches long and ½ inch thick, a raised collar nearly ¾ inch in diameter, and a square head; the whole thirteen screws weighing 24 ounces. She was fed on pudding and gruel, morphia was injected subcutaneously to relieve pain, and, after a few days ounce doses of castor oil were given daily. On the forty-first day, the first of the screws passed by the bowel, and, by the end of the sixth month, the last came away. The screws in their passage had lost 4¾ ounces in weight. This case occurred in the Bristol Asylum, under the care of Dr. Thompson. Poland has also recorded in his prize essay the case of a lunatic who died from ulceration of the duodenum owing to the pressure of a spoon handle that had been swallowed about three months before, with *thirty* others, besides nails, pebbles and pieces of iron. These foreign bodies were extracted from the stomach after death, and weighed in all forty ounces. The most complete list of cases of foreign bodies in the digestive canal will be found in the 'Union Médicale' for November, 1874, by Dr. Mignon.

In Guy's Museum (Prep. 1800) there is an enlarged and thickened stomach of a sailor who had swallowed clasp knives. He was æt. 23, and in June, 1799, he swallowed four clasp knives which were discharged from the bowels. In March, 1805, he swallowed from fifteen to twenty more, after which his health became impaired. He vomited the handle of one and passed portions of the blades of others, and in March, 1809, died in a state of exhaustion. After death one blade was found perforating the colon opposite the kidneys, but without extravasation of feces, and another was fixed across the rectum. In the stomach, too, were numerous blades partially dissolved, or between thirty and forty fragments in all.

At times, intestinal calculi form from the agglomeration of hair, husk, particularly oat husks, or other foreign substances, and prove fatal. Dr. Down has recorded such a case ('Path. Trans.,' 1867), in a boy, æt. 13, who died of exhaustion after 15 days' illness. Not many years ago I saw an artist, æt. 36, who died from intestinal obstruction, through whose abdominal walls a globular indurated mass was readily felt on the right of the umbilicus. I suspected it to be made of hair, for he was in the habit of sucking to an excess the paint brushes of his pupils, but the diagnosis could not be verified after death.

Treatment.—Rest in the horizontal position and expectant treatment are in these cases the two essential points to be observed, and purgatives should on no account be given. The "smasher," according to Pollock, who constantly swallows false coin, when caught in the act of passing it, avoids *purgatives*, but takes a constipating diet, such as hard-boiled eggs and cheese, together with his usual food, thinking that the money is more likely to be caught and consequently passed in a bulky stool than in a liquid one. The surgeon should act on this principle. When the foreign body becomes impacted in the stomach or intestine, or sets up inflammatory action and peritonitis, the thought of opening the abdomen may be entertained; that is, the surgeon may assist natural processes when they are doing their best to get rid of foreign substances by ulceration, and, when the foreign body is large and clearly cannot be passed, the surgeon should open the stomach by *gastrotomy*, ten cases out of eleven in which this operation has been performed having recovered. (*Vide* paper by Dr. Pooley, of New York, 'Richmond Med Journ.,' April, 1875.)

Gastrotomy and Gastrostomy.

When the stomach has to be opened for the removal of a foreign body the operation is rightly described as that of "gastrotomy." When the same operation is performed with a view to establish a permanent fistula for the introduction of food, as first performed by Sédillot in 1849, and described by him as gastro-stomie, the term "gastrostomy" seems to be the more applicable term. This change has been suggested by Dr. Pooley, of New York, and it seems so apposite that I now adopt it.

That the operation of gastrotomy is not necessarily fatal is proved by the fact, that it has been performed at least eleven times, and in ten with success, and though in the twenty-one cases in which gastrostomy has been undertaken for cancer, life has been never prolonged for more than forty days (Sydney Jones's case, 'Lancet,' May 15th, 1875), the evidence of the relief that it has afforded to those who have been subjected to it is sufficient to prove that it is based on a sound principle and a humane practice, for it ought to be remembered that in the twenty-one cases in which it was performed, it was undertaken more with a view of mitigating the horrors of a death from hunger and thirst, and of prolonging what remained of life than from any curative object, for in every instance the cause of the obstruction was cancerous stricture of the œsophagus. I have had an opportunity of watching the progress of three of these cases under the care of my colleagues, Messrs. Cooper Forster, and Durham, and of two under my own care; and I am free to acknowledge that the advantages given by the operation are worth the risk, and that if life were not prolonged, it was certainly rendered more endurable.

When, however, the operation is performed for a cicatricial stricture, better results may be expected, as proved by the records of the following interesting cases, operated upon at Rostock by Dr. Trendelenburg, March 8th, 1876 ('Med. Record,' March, 1878); and in Paris by M. Verneuil ('Gaz. des Hôp.,' Oct. 28th, 1876; 'Lancet,' Jan. 13th, 1877).

Trendelenburg's case was in a lad who had swallowed some sulphuric acid six months previously, and the stricture was in the lower end of the gullet. An incision was made parallel to and one inch below the left ribs, and a very small opening into the stomach. The sutures were passed through the whole thickness of the abdominal parietes and stomach, and a rapid recovery followed the operation. At the end of the fifth month the weight of the boy's body had increased by one-fourth. The boy took food as usual by the mouth, masticated it, and then blew the contents of his mouth through a long elastic tube directly from the mouth into the cavity of the stomach.

Verneuil's patient was a mason æt. 27, and the stricture a cicatricial one, due to the accidental swallowing of some caustic potash on February 4th, 1876. Œsophagotomy was out of the question, as the stricture was situated low down in the tube, and relief was called for because swallowing was impossible. On June 26th gastrostomy consequently was performed, and a rapid recovery followed. The man was up and about on August 20th. A caoutchouc sound was kept in the wound for feeding purposes. In the report of the case it is stated that when food is poured into the stomach the only sensation experienced is that of heat or cold. Saliva, however, is at the time freely secreted, and the man executes masticatory movements. Digestion goes on well without the aid of saliva.

These cases are most satisfactory, and are sufficient to encourage the belief that better success would follow this operation even when undertaken for cancer, if it were performed at an earlier period of disease than has hitherto been the practice.

We perform colotomy on a patient with cancerous stricture of the intestine or other mechanical obstruction without hesitation, and surgeons are now willing to admit the great advantages afforded by this means. Surely the advantages offered by gastrostomy for stricture of the œsophagus, cancerous or otherwise, are not less potent, and *should it be undertaken before the patient's powers have been brought to too low an ebb*, there is no reason why it should not be equally effective. In one of my own cases the man lived five days, and the operation had nothing to do with the death, there being no peritonitis, and the local repair was most complete. In the second case the patient lived two days. The operation has not hitherto, I believe, been successful, because it has been put off until too late; as also was colotomy unsuccessful till it was undertaken at an earlier stage of the disease, If gastrostomy has the same chance as colotomy now has, it will become as established an operation in surgery.

The operation.—Chloroform had better be given, as it is important that absolute quiet be maintained during the operation, although the risks of vomiting as a consequence are not slight. The patient should be placed upon his back, and an incision made on the left side below the ribs, the object being to find the cardiac end of the stomach in preference to the pyloric. The line of the linea semilunaris is that usually selected for incision—a cut three or four inches long being made through the tissues seriatim down to the fascia lining the muscles—every vessel being twisted or tied as it bleeds; but, in my own operations I make an oblique incision along the lower borders of the ribs, commencing at the linea semilunaris, and I do so with the view of catching the cardiac end of the stomach, and I may add that I pick up the stomach with my fingers very readily. The fascia and peritoneum can then be divided. With the thumb and finger the stomach can now be sought, and held when caught. This is best effected by the passage of a Liston's needle armed with a long double silk ligature through the margins of the wound and the stomach's coats, and a second about three-quarters of an inch lower down. The surgeon has then to fasten the stomach to the margins of the wound, and for this purpose the quill suture seems to be the best. The stomach should then be opened over the ligatures that have been passed through it by an incision being made in the line of the wound; the centre of the double ligatures will then become exposed, and these should be drawn well out and divided. There will then be two double ligatures through each side of the opening in the stomach and the margin of the wound. On tying the two ends over two pieces of bougie, one introduced against the inner suface of the stomach, and the other upon the integument, the parts are secured, the bougies admirably compressing the thin walls of the stomach against the integuments, and retaining them there. One or two other sutures will probably be required to close the wound, and an additional one at either end of the opening in the stomach to keep it in its place; the operation is then complete. When the quill suture is not used, the stomach must be stitched to the margins of the wound in the ordinary way, but a more accurate adaptation of the parts and greater security is acquired by the quill suture than any other, and what is more, the pieces of bougie are capital guides to the orifice into the stomach, the slightest traction upon them rendering it patent for feeding purposes; and with this object one of the sutures should be left long on either lip of the wound. After the operation, it is advisable to desist from giving food for a few hours, in order to give the stomach rest; although, after a day or so, liquid nourishment may be administered in small quantities through a tube, milk and eggs being probably the best, or milk alone. Where enemata can be tolerated, they should be used. Care must be observed that too much food is not given, as it retards progress, a quart or three pints of milk in twenty-four hours being sufficient. The edges of the wound should be carefully protected by oiled lint. The sutures may probably be removed wholly or in part on the fifth or sixth day. Schönborn, of Königsberg, advises the early performance of this operation while the stricture is still passable to small bougies, and to facilitate the operation advocates the use of a hollow bougie with a child's India-rubber ball on its top, which should be introduced by the gullet, and blown up in the stomach. This suggestion seems worthy of adoption when it can be acted upon.

It must be added that Sédillot was the first surgeon to perform the operation in 1849, and Mr. Cooper Forster, on the suggestion of Dr. Habershon, was the first to do it in this country in 1857. Since then Mr. Sydney Jones, Fenger of Copenhagen, Lanvielonque of Bordeaux, Durham, Le Gros Clark, Mac Cormac, T. Smith, V. Jackson, and myself, have had cases, making twenty-one in all.

When a foreign body becomes *impacted in the small intestine*, and life is threatened, it is a question how far the surgeon is justified in attempting its removal. I can see no reason why an attempt should not be made, when the course of the case has proved that natural processes are incompetent to rid the offending body and life is threatened by its presence.

When the *colon, cæcum, or its appendage*, is a seat impaction there is less objection to the attempt, for as *colotomy* is now known to be a valuable operation for cancerous or other obstruction of the rectum, and in cases of suppuration about the cæcum free incisions in the iliac fossa are of proved value, so laparotomy is not less likely to prove of service when the obstruction is caused by the presence of a foreign body.

INTESTINAL OBSTRUCTION.

In cases of acute or chronic intestinal obstruction when the physician's art has failed to give relief, the surgeon's aid is occasionally required, and it would be well for the medical mind to recognize the fact, that in a large proportion of instances, this aid is sought at too late a period—that is, when the patient's powers have become so exhausted as to exclude all hope of a successful issue being obtained by any treatment—or, when the involved tissues have undergone such changes from peritoneal complications as to forbid any reasonable expectation of the competency of nature's reparative powers to effect a cure; as cases of *acute* intestinal obstruction, like those of strangulated hernia, require prompt and active treatment if they are to be successful, while those of *chronic* obstruction require a no less decided line of action. It must be admitted, however, that there is no class of cases which claim for diagnostic purposes more thought and judgment, the difficulties of diagnosis as to the cause of the obstruction being sometimes great; the question of operative relief has consequently to be decided upon uncertain grounds.

Yet, when the diagnosis is clear and the nature of the case decided, delay is dangerous, and a want of courage to act upon the diagnosis is criminal in the surgeon. The question of diagnosis is consequently all important, and will first claim attention.

Diagnosis.—In a clinical point of view, cases of intestinal obstruction may be divided into *acute* and *chronic*. The *acute* include strangulation of a portion of bowel from internal hernia, omental, mesenteric, peritoneal, or fœtal bands, or twists of the intestine (volvulus). The *chronic*, inflammatory or cancerous strictures of the large or small intestine; the occlusion of the bowel from the mechanical pressure of tumors; adhesions of the intestines from chronic inflammatory peritoneal or former acute changes; and last, but not least, the impaction of fæces.

Perityphlitis and acute peritonitis due to perforation may also simulate the acute form. Intussusception belongs to both divisions, because when strangulated they may give rise to acute, and when incarcerated, to chronic symptoms, although the symptoms in their onset are always sudden. The relative frequency of these conditions will be seen in the following table:—

CAUSES OF INTESTINAL OBSTRUCTION, EXCLUDING HERNIA.

Being an analysis of 124 consecutive cases extracted from the post-mortem records of Guy's Hospital, by Dr. Hilton Fagge, from 1854 to 1868 ('Guy's Rep.,' 1868); and Mr. Russel, from 1858 to 1876 (unpublished).

Analysis of 63 cases of Stricture of Intestines as given in a Paper by Coupland & Morris. ('Brit. Med. Journ.,' Jan. 26, 1878.)

Guy's Cases.				Middlesex Cases. 28 Large Intestines, 3 Small.	Pathological Society. 31 Large Intestines, 1 Small.		General Total.
33. ACUTE OBSTRUCTION	1 Internal hernia.						
	7 Twists (volvulus).						
	25 Bands.	14 Lymph.					
		6 Diverticula.					
		2 Appendicæci.					
		2 to neck of hernial sac.					
		1 from pedicle of ovarian tumor.					
76. CHRONIC OBSTRUCTION	3 Fæcal impaction.						
	3 Mechanical pressure of tumors.						
	47 Stricture	2 Small intestine.					
		45 Large	33 Rectum and sigmoid flexure	24	21	=	78
			7 Transverse colon with hepatic and splenic flexures	3	9	=	19
			5 Cæcum or ilio-cæcal . . .	1	1	=	7
	23 Matting together of intestinal coils from peritoneal and cancerous disease. (Contractions.)						
							104
15. INTUSSUSCEPTIONS	2 Rectal.						
	7 Ileo-cæcal.						
	6 Small intestine.						
124							

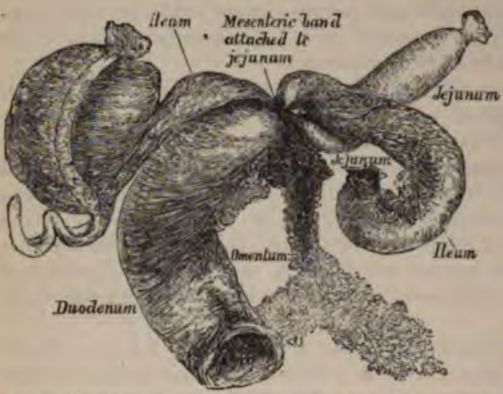
In all cases of intestinal obstruction the diagnosis should be made upon the principle of exclusion, the practitioner coming to a conclusion by first running over every possible cause, and eliminating each seriatim, and subsequently weighing the points in favor of the probable cause.

The possibility of the symptoms being due to a strangulated or incarcerated external hernia should always be carefully investigated.

ACUTE INTERNAL STRANGULATION OF THE BOWEL,

whether from an internal hernia, twist (volvulus) or a fœtal or peritoneal lymph band, may take place at any period of life, and the symptoms to which it gives rise are those of an acute strangulated external hernia, viz., sudden and definite onset of the illness in a healthy subject, severe paroxysmal central abdominal pain attended by sickness and more or less collapse; constipation, inability to pass wind downwards, and hiccough; occasionally also scanty urine, or even its suppression, and visible coils of distended bowel.

FIG. 256.



Case of strangulation of the bowel by lymph-band constricting ileum about three inches from cæcum and a coil of jejunum. Taken from a man, æt. 26, who died after bowel obstruction of 15 days' duration. This case occurred in my father's practice in 1838, and is recorded in 'Trans. Med. Soc. of London,' 1846. The suggestion was then made of operative interference.

There will, however, be no abdominal tumor, no tenesmus, and no hemorrhage from the bowel.

When, therefore, a case presents itself with these symptoms there can be no difficulty in coming to a conclusion as to its nature, although it may be difficult, if not impossible, to diagnose the precise cause of the strangulation. If, however, we refer to the table at page 443, some guide will be found, for it will there be seen that out of 33 cases 25 were due to bands, 7 to volvulus, and 1 to internal hernia.

When there has been a history of old hernia, the probabilities of the existence of a band are much enhanced, since it is true that with hernia such bands are not uncommon. Duchaussoy, in his paper "On Internal Strangulation" ('Mém. de l'Acad. de Méd.,' 1860), gives such cases. Fagge quotes one, and in my own practice three have occurred; one died unrelieved; in the second, I opened the empty hernial sac, and so enlarged my incision upwards for about two inches as to detect a band high up in the abdomen, which I divided with a pair of scissors, and a perfect recovery took place. This case occurred in the practice of Dr. Wilkinson, of Sydenham, and is fully recorded in the 'Med.-Chir. Trans.' for 1867. The patient is still alive. The third died after the operation, but the band was divided and a large coil of intestine released. . The operation had been delayed too long.

Mr. Gay's analysis of 148 cases tells us that 102 were in the male and 46 in the female, and that the largest number of cases took place in patients between 15 and 35.

The surgeon, under the circumstances related, however, has a clear case and an important decision before him, for if the diagnosis be correct, and a portion of bowel is *strangulated* within the abdomen, obstructed by some solitary band or twisted, he knows that very little can be looked for by medical treatment—that by leaving things alone, and the case is unrelieved, death is inevitable; and he is aware, moreover, that the hope of a cure by natural processes is very meagre; and if I estimate that hope as being nearly on a par with that entertained in a case of ordinary strangulated hernia when left to itself, I shall probably be about the mark, since cases of strangulated hernia do *occasionally* go up of themselves when all surgical efforts to reduce them have failed less than herniotomy; and, cases of internal strangulation, from whatever cause, do *occasionally* free themselves. Nevertheless, no prudent mind, on the strength of these exceptional occurrences, would willingly leave a case of external strangulated hernia to itself with the vague chance of its self-reduction; and I think that no prudent surgeon ought to leave any case of internal hernia or strangulation unrelieved with the same almost forlorn hope; because, granting that the diagnosis of the case can be made, by no medicine, no manipulation, no expectant treatment can the mechanical obstruction be overcome, and, under these circumstances, a fatal termination must be anticipated.

Opium may relieve pain, mask symptoms, and give rise to a pleasing delusion that all is doing well in cases of internal strangulation, as it is well known it does in others of external hernia; but in the one, as in the other, it does no more. It does not accomplish the only true remedy—viz., relieve the mechanical strangulation to which the bowel is subjected.

In external hernia, the only recognized correct treatment is herniotomy, and I submit that in internal hernia or its equivalent the only sound practice is "laparotomy."

The operation of ovariotomy has proved to us, that the exposure and manipulation of healthy intestine is not of itself a fatal measure, and there is every reason to believe that he cases now under consideration, a good result might often be secured if the opera- were performed before a fatal peritonitis had set in or the strangulated bowel been red past recovery. At any rate, as matters now stand, a recovery by medical treat- t from an internal strangulation is a matter of wonder, and it would be well, as all lateral experience indicates, that a bolder practice should be employed.

A Help to Diagnosis in Cases of Abdominal Obstruction.

"Let no one set too much value on any one sign or symptom."—Fagge.

	Acute—	Chronic Obstruction.		Acute or Chronic—
	Obstruction or Strangulation.	From Disease of Large Intestine.	From Disease of Small Intestine.	Intussusception.
Previous condition of subject	In good health . .	Ailing for some time with abdominal symptoms	Ailing, with previous attacks or incomplete obstruction.	In good health.
Mode of attack . .	Very sudden and acute.	Symptoms gradually increasing in severity, or acute grafted upon old.	Paroxysms of colicky pain, upon old symptoms.	Sudden onset, and increasing when acute, subsiding when chronic.
Early symptoms—				
Pain. . . .	*Abdominal pain*—fixed, central, and paroxysmal.	*Pain* diffused and increasing with distension	*Pain*—paroxysmal, with intervals of ease and hypogastric.	*Pain* fixed and often relieved by pressure.
Vomiting . .	*Vomiting* rapidly becoming fecal.	Intermittent and fecal towards the last.	Occasional during attack of pain.	Rapidly becoming fecal in acute cases, absent or intermittent in chronic.
Collapse . .	*Collapse* very marked.	Absent till the end .	Absent till late.	Very marked in acute cases, not so in chronic.
Constipation .	Absolute constipation and inability to pass flatus.	Gradually increasing in severity.	Attacks of constipation, alternating with natural relief.	Occasionally present, but, as a rule, "dysenteric" symptoms, straining, tenesmus, muco-sanguineous stools, or hemorrhage.
Abdominal distension.	Rapid and severe, central and hypogastric.	Gradually increasing, lumbar and epigastric.	Never great, increased during attack.	Rarely severe.
Manipular indications.	Tympanitic, distended coils at times to be felt.	A fixed swelling at times to be felt in either iliac fossa.	A doughy condition of bowel, becoming knotty during attack.	Distinct tumor often to be felt, its shape varying during attack.
Visible indications	Abdomen tense in umbilical and hypogastric regions, with visibly distended coils.	Abdomen broadly distended, coils of intestine visible.	Coils of intestine, very visible.	Nothing marked to be seen.
Peristalsis .	Rarely visible . .	Marked.	Very marked . . .	Not visible.
Urine . . .	Scanty or suppressed.	Natural in quantity .	Natural	Natural.
Rectal examination	Lower bowel probably quite empty.	Stricture of bowel may be felt in rectum or in sigmoid flexure by manual examination.	Nothing abnormal. .	Rectum may contain mucus or invaginated bowel.

If we appeal to pathology, and it is only there unfortunately that we can appeal, we receive ample facts, since Dr. Fagge, in his able article already referred to, tells us that "there might in many cases have been no little difficulty in finding a band among the distended coils, but I regard the facts derivable from our post-mortem records as indicating no insurmountable obstacles to the success of an exploratory operation in the great majority of the cases of true internal strangulation, which are to be found in these records." Dr. Brinton, in his analysis of 600 cases, points also to the same conclusions. Under these circumstances, I feel bound to express my convictions, that on the diagnosis being made of an internal strangulation, from whatever cause, the operation of "laparotomy" should be performed. But this operation is not to be performed as a "dernier ressort" more than that for external hernia, but should be carried out as early in the progress of the case as the diagnosis will justify—when, in spite of the gravity of the measure, good results may be looked for.

Chronic Intestinal Obstruction

now claims attention, and it is to be observed "in limine" that the clinical history of these cases is very distinct from that of the acute; for, whereas in the latter, the symptoms appear, as a rule, suddenly in patients who have been apparently in good health—in the former it will almost always be found that there has been for a more or less lengthened period some abdominal pain or symptom; some difficulty in obtaining a movement of the bowels or in the act of defecation—some discharge probably of glairy mucus, of pus or of blood, separately or combined at uncertain intervals; and last, but not least, some change in the form and character of the stools, the motions at one time being liquid and loose, at another hard and marble-like, while at intervals they are pipe or tape-like. Under all circumstances there must be symptoms of long standing, and, if more acute symptoms exist when the case comes under notice, they will be found to have been grafted upon the old. If, therefore, we are called to see a patient suffering from marked symptoms of obstruction of some days' duration, and obtain such a history of the case as has just been sketched, and find him with abdominal tympanitic distension and probably pain, possibly visible peristalsis, nausea, vomiting, hiccough, and borborygmi, we may safely come to the conclusion that the case is one of chronic obstruction, and that it has for its cause one of those named in the table (page 443). It will prove to be either stricture of the colon or rectum, the mechanical pressure of a pelvic or abdominal tumor, the matting together of the intestinal coils from old or chronic inflammation of the peritoneum or mesentery, or from cancerous abscess; and last but not least, to fecal accumulations, and in every case of obstruction the last possibility being the cause should be borne in mind. Rare instances are also on record in which other causes have existed; and I have given in the chapter on hernia, some in which the obstruction had been clearly traced to the influence of an adhesion between the bowel and a hernial sac or some part of the abdominal parietes, or to an obstructed obdurator or other hernia.

Now the effects of obstruction, from whatever cause, are very uniform, and terminate fatally from either exhaustion or peritonitis if the obstruction is not overcome; the chronic peritonitis being directly due to the obstruction, and the acute to either a perforating ulcer of the sigmoid flexure secondary to the stricture, to some ulceration of the cæcum or colon, the result of the overdistension, or to the mechanical rupture of the cæcum the direct result of the pressure of the fecal accumulation acting backwards upon the cæcal cul-de-sac, my notes describing two cases in which the cæcum burst; one in which it was purple in color, and measured fifteen inches round; and another in which it had sloughed. I have also notes of a case of a male child born with an imperforate rectum, who died on the sixth day from ruptured cæcum. And out of eleven consecutive fatal cases of untreated stricture of the rectum at Guy's Hospital collected by my dresser, Mr. Russell, death was caused by ruptured cæcum in three, by perforation of the sigmoid flexure in two, by peritonitis after puncture to relieve flatus in one, and by exhaustion in three. Hence the importance of early relief before these changes have been started. These points have been ably brought out in Coupland and Morris's paper.

To diagnose the true cause of the obstruction is therefore the surgeon's next aim, and it would be well if I were able to add that the task is an easy one; but such is not the case. It is true when the obstruction is in the rectum that a digital examination of the part may find it out; when in the sigmoid flexure that the cautious introduction of the whole hand into the rectum (after the method of Simon, of Heidelberg) may detect it, and that when a tumor is to be felt by palpation to the left of the umbilicus through the abdominal walls the probability is suggested of the disease being in the colon, but without these guides little definite knowledge is to be obtained by either palpation or percussion, by the passage of the long tube, or by the amount of fluid that may be injected into the colon.

Under these circumstances, therefore, the surgeon is thrown back upon the probabilities of the case as read by the light of pathological knowledge and it is gratifying to be able to show that these facts speak with no uncertain sound. Indeed, they speak so strongly and decidedly, that the surgeon may rely upon them with confidence, and base his practice upon their indications.

The facts are revealed in the table to which I have already drawn attention. There it will be seen that out of the 76 fatal cases of chronic obstruction 3 were due to fecal impaction, 3 to the mechanical pressure of tumors; 23 to what Dr. Fagge described as "contraction" caused by the matting together of the intestinal coils from peritoneal or cancerous disease, and 47 to strictures of the bowel.

Now, cases of fecal accumulation do not require any lengthened treatment in these pages; when they come under the surgeon's care as examples of obstruction they are to be treated by the mechanical removal of the feces from the rectum by such means as the finger, the lithotomy scoop or the handle of an iron spoon—these measures being aided materially by the free use of grease, oily enemata and medicines.

The fact that fecal accumulations may give rise to the worst symptoms of mechanical obstruction and even to death should always be before the surgeon, and induce him to examine the rectum with care in all probable cases.

Obstructions due to the presence of some abdominal tumor, hydatid, cancerous, ovarian, or otherwise, are to be diagnosed and dealt with on their own merits, although when it is the lower part of the bowel that is obstructed, right or left lumbar colotomy should not be neglected when other means of relief are not available. I have performed this operation on most occasions from such a cause with gratifying success.

We come now to the two larger divisions of cases, viz., those of *stricture* and of *contractions*, and a very little consideration will show that these cases have as distinct a clinical history as they have a pathology, and that they, moreover, require a distinct line of treatment.

With respect to their pathology it may at once be stated that "contraction" is the cause of chronic obstruction of the small intestines, and "stricture" of obstruction of the large bowel.

That the cases of "contraction" are due to the matting together of the intestinal coils from more or less diffused inflammatory or cancerous peritoneal disease, while cases of stricture are due to a local narrowing of the bowel from disease of its coats.

In the cases of "contraction" the action of the intestines (small or large) is interfered with from adhesions or from a bending or doubling of the bowel upon itself, and consequently there is an interference with the peristaltic movements. In those of "stricture" the action of the bowels is prevented from the direct mechanical obstruction occasioned by the stricture.

The clinical history and symptoms of these two classes of cases consequently differ.

In the case of "contraction" the symptoms are clearly referable to a difficulty in the passage downwards of the intestinal contents; in that of "stricture" to a difficulty in defecation.

In the former case the symptoms are attacks of griping colicky abdominal pain, irregular and incomplete intestinal evacuations, and the painless discharge of healthy motions. In the latter there is mostly an absence of abdominal pain beyond that due to distension, more or less complete constipation, alternating with looseness of bowels, the occasional or frequent mixture of mucus or blood with the motions and painful defecation.

In "contraction" when sickness exists it will be passing and lasting only during the attack of colicky pain. In "stricture" it will occur towards the close of the disease when the obstruction is more complete.

In "contractions" the abdomen probably will not be much distended and if it be so, only during the attack, the distension, moreover, will be central and hypogastric. "The intestines will then," writes Fagge, "be seen writhing and coiling, and a gurgling of fluid is heard; there will also be visible distinct peristaltic movements of the intestines." In "stricture" the abdomen will to a certainty be distended and the distension will be lumbar and epigastric; large coils of distended bowel will also be visible with peristaltic movements, the visible peristalsis in both cases being due to the chronicity of the affection and consequently to the hypertrophy of the bowel from overwork.

Such then are the broad points of distinction between the two large classes of cases of chronic intestinal obstruction, and they are enough to guide the surgeon in his practice. At times, however, the distinctions fail. Indeed, when the history of a case of either contraction or stricture is deficient, the diagnosis is most difficult, and if seen when the symptoms are at their height one or other may be mistaken for cases of acute obstruction, the chronic symptoms of which nothing can be known, having lighted up into the visibly acute, in the same way as a case of incarcerated or instructed hernia may suddenly develop into one of acute strangulation.

Having then thus mapped out the chief points of distinction between the two classes of cases of chronic intestinal obstruction, and bearing in mind that in the "contractions" the small intestines are the parts that are involved and in the "strictures" the large, it remains for the surgeon in the latter class of cases to determine the seat of the disease, for a correct knowledge upon this point is clearly requisite before any precise operative treatment can be entertained. On reference to the table, this point comes out very strongly—for out of 104 cases which have been tabulated, in 78 the disease was in the sigmoid flexure or rectum; in 19 it was in the colon or one of its flexures; and in 7 it was about the cæcum. In three-fourths of the cases the disease was consequently below that part of the bowel that would be opened by left lumbar colotomy, and in about one-fifth by right; in but a very insignificant number was it higher up.

With these hard facts before us, the conclusion seems tolerably clear, that in all cases of obstinate constipation due to mechanical obstruction in the large intestine, when medicinal treatment has failed, and the removal of the disease by operative measures is out of the question, instead of wasting valuable time by the persistent administration of aperients which must do harm, of enemata which can do no good, of opium and allied remedies which only mask symptoms and mislead the practitioner, colotomy should be performed. In the *left* loin, when the diagnosis has been made of disease of the rectum or sigmoid flexure, and in the *right* when the exact position of the stricture cannot be determined; for from our table it would appear that in not one case in fifteen is it likely to be above this point; right lumbar colotomy also so far as the relief it gives is as satisfactory an operation as left. It must be stated, moreover, that this relief should not be postponed too long, because from the facts alleged the operation will be of little avail when from the mechanical effects of the fecal distension a peritoneal inflammation has set in, or changes have taken place in the cæcum or large intestine of an ulcerative or inflammatory character.

With respect to the treatment of "contractions," much may be done by judicious medical measures, more particularly by helping the passage onwards of the contents of the intestinal canal, by means of laxatives, those of an oily kind being the best, such as the oily mixture of the Guy's Pharmacopœia.

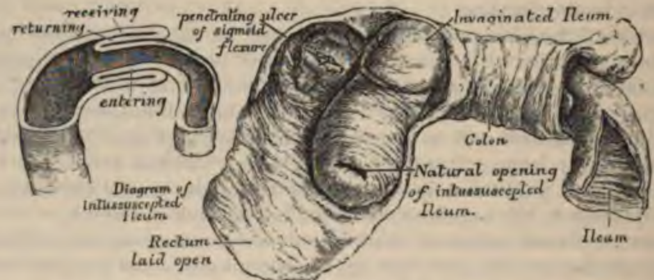
A time will, however, come when these means will fail and others must be looked for, unless the patient be left to his fate; and of these "enterotomy" is most applicable. The operation consists in opening the small intestine in the right or left iliac fossa, and so establishing an artificial anus.

The operation will be considered further on.

INTUSSUSCEPTIONS,

or the invagination of some portion of the bowel into a lower segment (Fig. 257), may occur at any period, though more common in infancy and child life. They may take place also in any part of the intestine—my table recording that out of the 15 cases tabulated, 2 were rectal, 7 ileo-cæcal, and 6 small intestine. These statistics are supported by Guy's analysis of 74 cases, in which 8 involved the large intestine alone and were colic, 33 ileo-cæcal, and 33 small intestine. The rectal variety is, however, more frequently found in the adult, the iliac in young adults, and the ileo-cæcal in infancy and childhood. When the invaginated portion of intestine becomes *strangulated*, the symptoms are acute; when simply *incarcerated*, they may be chronic. Sudden invasion of symptoms, however, is the rule in both forms, with tenesmus and muco-sanguineous discharges, more particularly when the ileum is involved; discharge of blood per rectum occurs in the acutest cases.

FIG. 257.


receiving
returning
entering
Diagram of intussuscepted ileum
penetrating ulcer of sigmoid flexure
Rectum laid open
Invaginated Ileum
Colon
Natural opening of intussuscepted Ileum.
Ileum

Intussusception, with diagram showing the entering, returning, and receiving layers of ileum into colon.

The symptoms may be very acute and destroy life in three days, or so mild as to be only those of intestinal irritation. The development of symptoms as well pointed out by Mr. Howard Marsh ('St. Barth. Rep.,' vol. xii, 1876, p. 68) depending upon the occurrence of constriction—an intussusception in this respect being like a hernia, which may be "down" without being strangulated or even obstructed—the various symptoms in each case depending, not on the mere displacement of the intestine but on the constriction produced by the displacement.

When *acute*, a case of intussusception at its onset may be mistaken for one of "band," and yet marked points of difference exist between the two. In both, the attack is sudden, and followed by collapse, but in the case of a *band*, pain is localized from the first, is paroxysmal, and remains severe to the last, and is also unassociated with tenesmus. In the *intussusception*, pain varies much both in seat and intensity, is often relieved by pressure, and towards the last ceases. The pain is likewise commonly associated with tenesmus. In "band," vomiting soon becomes fecal and is constant; in intussusception it may also be the same, but it as often ceases. In "band," constipation is the rule, with inability to pass flatus; in "invagination" diarrhœa, tenesmus and bloody mucoid stools are characteristic; constipation is, however, at times present in chronic cases. In "band," central and hypogastric abdominal distension is an early symptom, in "intussusception," it may never exist. In "band," the most that may be felt is a single coil of distended bowel; in 'invagination" a distinct tumor may be felt.

Dr. Leichtenstein, of Tübingen, in a valuable analysis of 593 cases of this affection ('Prager Vierteljahrschrift,' Bd. 119, 121, 1874), informs us that when a tumor is recognized in the epigastric region, the ileum is probably the part invaginated; when in the right iliac fossa the ilium into the cæcum; and when it can be felt in the rectum it is probably ileum. Mr. Morris ('Path. Trans.,' p. 133, 1877), has, however, pointed out the possibility of mistaking blood clot in the rectum for the lower end of intussuscepted bowel, so that the use of the speculum should be brought to the aid of the finger in any case of doubt. Leichtenstein says also that when the intussuscepted portion of bowel sloughs off it occurs between the eleventh or twenty-first day from the beginning of the disease, and that it is generally part of the ileum. This result, however, is very rarely met with in infancy.

In the treatment of intussusception, operative interference is not to be undertaken in a hurry, as it is not to be questioned that cases of this affection constantly occur which right themselves either by or even without the aid of medical or surgical treatment, the bowel either freeing itself by an unexplained process, or, in some acute cases sloughing away, and a so-called cure resulting. Fagge, however, well observes upon this point that "when this cure by expulsion occurs it frequently only postpones the fatal termination instead of entirely preventing it. The patient dies some months afterwards from contraction of the cicatrix which had formed at the seat of the disease, this fact affording a weighty additional argument in favor of an attempt to explore and pull out an ileo-cæcal intussusception when the case is correctly diagnosed at an early stage." Mr. Morris says "it would appear that when small intestine is intussuscepted into *small* intestine the *invaginating* portion, owing to its small relative size, is too much damaged by compression from within to allow of recovery by expulsion of the reflected and entering portions."

No operation should, however, be thought of in intussusception until well-considered minor measures have been employed and failed, care being taken that too much time is not expended in the attempt. In *acute* intussusception, however, where the bowel is clearly strangulated, but a few hours should be given, because unless relief is speedily found, death ensues, and the younger the patient the more rapid the result.

In *chronic* intussusception where the bowel is probably only incarcerated, the surgeon should not withhold his hand for more than a week; because if relief is to be obtained by treatment, it should be obtained within the seven days it is justifiable to expend in the attempt, and, if failure follows, the operation of laparotomy should be undertaken. In acute strangulation if relief is not speedily found, sloughing of the invaginated bowel may take place, and in the chronic, adhesion of the invaginated bowel; under either circumstance operative interference must fail.

Operative interference in intussusception, however, has not hitherto been very successful, and its failure, I believe, is owing to its having always been postponed to too late a period. Yet recent experience has been more encouraging, even under not very favorable circumstances, for Hutchinson has recorded a case ('Med.-Chir. Trans.,' vol. lvii, 1874) in which he opened the abdomen of a child æt. 2 on the thirtieth day of the symptoms, and drew out the invaginated bowel with a successful issue. Mr. Howard Marsh had a second case, in which a like good result was obtained in a male infant seven months old after symptoms of fourteen days' duration; while my colleague, Mr. Howse, had a third, in a woman æt. 23, a patient of Dr. Fagge's (ibid., vol. lix, 1876) in which recovery took place. I have likewise performed the same operation in a dog, pulling out on the fifteenth day, with a good result, six feet of invaginated bowel.

Dr. H. B. Sands, of New York, has also published another successful case in a child 6 months old ('New York Med. Journ,' June, 1877)—the operation having been performed eighteen hours after the appearance of the symptoms. In intussusception, however, some success has followed, at times, the practice of inflation, a plan of treatment that was originally recommended by Gorham years ago, and which may be effectually carried out by connecting a syphon bottle of soda or other aërated water with a tube passed well into the bowel, the elastic gas forcing its way far better than water. When inflation cannot be used injections may be substituted. This operation has, however, its dangers, as bowels have been ruptured by its use. I cannot therefore recommend it.

Inversion of the body has likewise been advised, with the chance, that the weight of the contents of the bowel above the involuted or obstructed segment may suffice to disengage it. Mechanical kneading of the abdomen, and the administration of an anæsthetic have also been employed with a similar object.

Opium should always be given in all cases of mechanical obstruction, the drug not only relieving pain, but checking the peristaltic action of the bowel which is so injurious.

These remedies, however, are uncertain at the best, and should be tried in early cases, when the diagnosis is uncertain and operative interference rejected, but they must not be used when more active treatment is called for unless such treatment is absolutely forbidden.

Laparotomy,

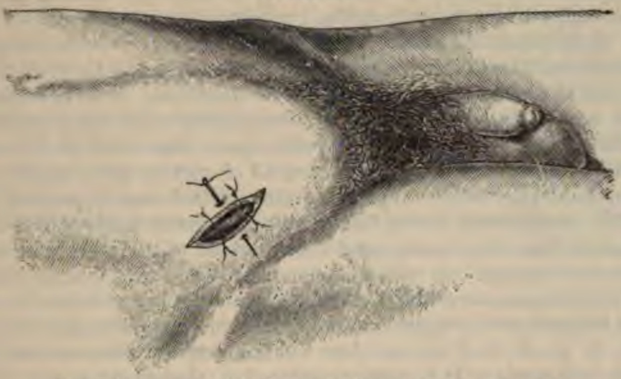
from λαπαρα, the soft parts of the body below the ribs, and τεμνω, I cut, is a name which has been given by Dr. John Ashhurst, Jun. (' American Journ. of Med. Science,' 1874), to an exploratory operation upon the abdomen for the relief of an internal strangulation or intussusception, and is so good that I adopt it. The term "gastrotomy" is applied to operations upon the stomach for the removal of foreign bodies, "gastrostomy" to an operation upon the stomach with a view of establishing a permanent fistula, "colotomy" to those upon the large intestine, and "enterotomy" to those upon the small.

In laparotomy the abdomen should be opened in the median line below the umbilicus, though if an old hernia exists, the sac should be explored, and the abdominal incision made upwards from its neck. The abdomen should at first be explored by the finger, and more particularly towards the umbilicus, since it seems that bands are more often found opposite the promontory of the sacrum than anywhere else. If the finger fail to find out the band, the opening must be enlarged and the parts inspected. When the operation is performed for intussusception, and the bowel is exposed, difficulty has been experienced in freeing the involved bowel, and, under such circumstances, the expedient used by Mr. Hutchinson should be employed and the invaginated portion pushed out backward from its sheath. The wound should be carefully adjusted by stitches. After the operation, the patient should be kept under the influence of opium or morphia—the morphia suppository every five hours being the best form to use. Milk diet should be given in small quantities, and, if recovery is to follow, it will probably be speedy; as repair takes place rapidly in all abdominal sections when a case goes on well, and death ensues early when the reverse occurs.

Enterotomy,

or the opening of some portion of the small bowel generally in the right groin, is an operation of great value, and it is to be regretted that it has not received sufficient notice. It was first performed by Nélaton, at least twenty-five years ago, upon a patient of Trousseau's, for chronic intestinal obstruction, and is applicable to cases of abdominal obstruction in which the clinical evidence points to the conclusion that the obstruction is high up in the large intestine or low down in the small; to cases in which "laparotomy" is inapplicable and "lumbar colotomy" is out of court—to cases of obstruction in which relief is required and a more exact method of giving it is not clear, either from some difficulty in diagnosis or other cause. It is described by Trousseau as follows (' Clin. Med.,' lecture 77):—"I begin the operation, as Nélaton advises, by making in the right side an incision an inch in length, a little above the crest of the ilium, parallel with Poupart's ligament (Fig. 258); the length of this incision is subsequently increased to three or four inches. In dividing, layer by layer, the skin, the cellular tissue, the muscles, and aponeurosis, tying as may be required the large vessels involved in the incision, we at last come to the most deeply-seated aponeurosis. Proceeding always very slowly, and being very particular in sponging the wound carefully, this deep aponeurosis is cut through, when forthwith the peritoneum is reached. It is taken hold of by a small forceps and incised; afterwards using the greatest possible precautions, a silver thread, by means of a curved needle is carried, first through the intestine and then through the abdominal walls; four sutures are then made, two on each side of the incision; two others are made, one at the superior and the other at the inferior angle of the wound; but this time the abdominal parietes are first perforated, then the intestine, and afterwards the abdominal parietes on the opposite side of the wound (*vide* Fig. 258A). In this way the intestine is fixed everywhere, laterally and from above downwards, to the walls of the abdomen; by this proceeding no exudation can take place into the peritoneum. *It is then only necessary to make an exceedingly small incision in the intestine* by means of a sharp-pointed bistoury. The opening which Nélaton makes is less than a third of an inch."

FIG. 258.

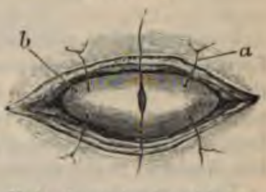


Inguinal wound made in Nelaton's 'Operation of Enterotomy.'

This operation is very warmly advocated by Trousseau in all cases of intestinal occlusion from whatever cause, "when the symptoms of occlusion have existed for six or eight days, when there is great tympanitis, when the matters vomited are of a stercoraceous character, and, finally, when the persistence and severity of the symptoms presage imminent death." He had recommended its adoption in five cases, and in two with complete success, the patients recovering, who, without it, would have been hopelessly lost.

In recent times this operation has been successfully performed by Mr. McCarthy on the suggestion of Mr. Maunder in 1872 ('Med.-Chir. Trans.,' vol. lv), by Mr. Wagstaffe ('St. Thomas's Hosp. Rep.,' 1873), by Mr. Maunder himself in November, 1875 ('Trans. Clin. Soc., vol. ix, 1876), and by others.

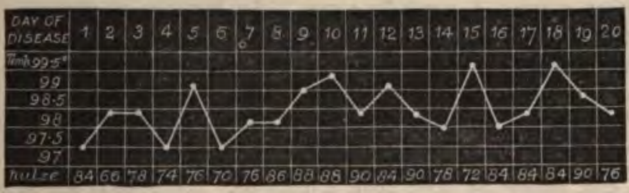
FIG. 258A.



Mode of securing bowel before opening it.

I have performed it three times, once in 1876 on an infant twelve days old, who was born with an imperforate rectum, and survived the operation eight days, having been greatly relieved by it, but operation had been postponed until too late. The second was in May, 1877, on a man æt. 57, who had been a patient of Dr. Wilks, for chronic small intestinal obstruction of many months' standing, the chronic condition being aggravated every week or ten days by symptoms of a severe character, which threatened life. The seat of the obstruction was too uncertain to allow of the operation of colotomy being performed; indeed the symptoms pointed to the small bowel as being the seat of the disease, and on that account enterotomy was undertaken. The operation gave rapid and permanent relief and the man was convalescent in a month. His temperature, as shown by the chart, was never higher than 100°. He is alive and well at the present day; but the inconvenience connected with the artificial anus is so troublesome as to neutralize greatly the

FIG. 259.



Thermograph of case of enterotomy, in a man, æt. 57, for chronic obstruction. Temperature never reached 100°, and patient was convalescent in a month. Fluctuation of temperature very slight.

advantages of the operation. The third was on the person of a man, æt. 50, whom I saw in consultation with Dr. Cortis, of Kennington, in July, 1877, for complete intestinal obstruction. He had been ill two months with abdominal pain and constipation, but sought advice only when the pain had become very severe and vomiting appeared. When I saw him, the constipation was insuperable, vomiting incessant, and the abdomen much distended. No obstruction could be felt in the rectum; both loins were very resonant, and it was believed that the obstruction was about the cæcum. I consequently performed Nélaton's operation of enterotomy as described, on July 7th. The operation gave immediate relief, and everything went on well subsequently, the temperature never rising beyond 99°. He left the hospital six weeks afterwards, the whole of his motions passing through the artificial anus, and not a trace of wind or motion passing per anum.

On his return home, for want of good nursing, a bed sore appeared, and he died in November, 1877. After death it was found, that the lower part of the ileum had been opened three inches from the cæcum, and that the seat of stricture was in the ascending colon just above the cæcum. It was cicatricial, and evidently due to the contraction of some old ulcer; the viscera were healthy. I subsequently learnt from Dr. Cortis that this patient had hurt himself in the right side of his abdomen three years before his illness in a fall over a case of goods, that the accident was followed by sickness and pain, with nausea and occasional vomiting. It is quite possible that the stricture was the result of this injury.

This patient, as well as the other, complained sadly of the annoyance caused by the constant flow of feces from the inguinal anus, no mechanical appliance having the power of controlling it.

COLOTOMY.

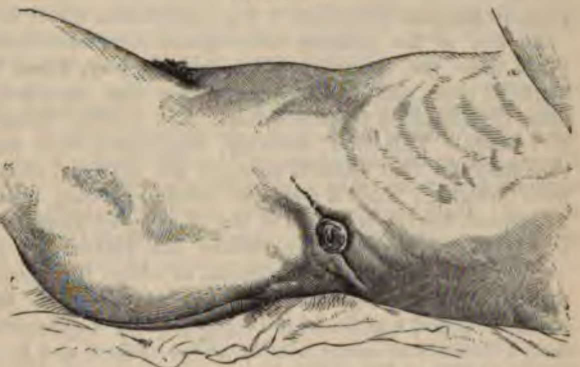
For irremedial stricture or mechanical obstruction of the rectum from any cause, *Callisen's* operation of opening the colon in the *left* loin should always be followed; but, when the seat of obstruction is higher than the rectum and if there be a doubt whether it is in the sigmoid flexure or transverse colon *Amussat's* operation in the right loin should be performed. Callisen first suggested colotomy in 1796, and applied it to the descending colon, but Amussat revived the operation and extended it to the ascending colon in 1839.

The colon in this position lies behind the peritoneum immediately beneath the transversalis fascia. The kidney is in close contact with it above, and in one case on which I operated, the organ was placed so low down as to fill in the space between the rib and pelvis, and had to be pushed upwards to allow the colon to be seen and opened. The operation can be performed as follows, on the left loin:—

The patient is to be placed on his right side with a pillow beneath the loin, in order to arch somewhat the left flank, and turned two-thirds over on his face; the outer border of the quadratus lumborum muscle can then be made out, as this muscle is the surgeon's main guide. Its outer border with the descending colon is to be found half an inch posterior to the centre of the crest of the ileum, the centre being the point midway between the anterior superior and posterior superior spinous processes. Allingham says that in more than fifty dissections he has always found the descending colon to be so situated. He has never known this point to fail him. When difficulties are felt in the operation, he believes they arise from the colon being looked for too far from the spine ('St. Thomas's Hosp. Reports,' 1870), and in that opinion I cordially agree. An incision is then to be made four or five inches long, beginning an inch and a half to the left of the spine below the last rib, and passing downwards and forwards parallel with the crest of the ileum; the line of the incision should pass obliquely across the external border of the quadratus lumborum muscle about its centre, so as to take the same direction as the nerves which traverse this part. By this incision, the integuments and muscles and fascia are divided, and the outer border of the quadratus muscle exposed. The abdominal muscles can be divided to give room, and this had better be done upon a director. All vessels are now to be secured. The transversalis fascia will next come into view, and beneath this will be the colon, a layer of fat sometimes intervening. The fascia is to be opened with caution, for in the loose fat and cellular tissue the colon is to be found; when distended, the bowel comes at once under the eye on dividing the fascia, but when empty, some little trouble may be experienced in hooking it up with the finger. It can always be found in front of the lower border of the kidney. This organ should consequently be sought, as it is the only certain guide to the bowel. I have found, however, on several occasions at this stage of the proceeding, great help by rolling the patient over on to his back, the bowel falling by this manœuvre on the finger, and being then readily caught.

When the bowel has been caught, it should be partially rolled forward, in order to expose its posterior surface, for if this be not done there is a risk of the surgeon wounding the peritoneum where it is reflected from its anterior surface on to the abdominal wall. The bowel having been drawn up to the wound is then to be secured to the integument and not to the muscles, by the passage of a ligature introduced through one margin of the wound, then through the bowel, and lastly through the other margin. The bowel can then be opened by a longitudinal incision about three quarters of an inch long over the ligature that has traversed its canal; the centre of the ligature is then to be drawn out and divided, the two halves of the ligature fixing the two sides of the divided intestine firmly to the margins of the wound; and two or four more stitches may then be introduced to make the artificial anus secure. The margins of the wound may be oiled to guard against the irritation of feces, and the patient placed in bed. At times, the feces escape in large quantities directly the bowel is opened; at others some slight feculent discharge will take place at the time, the larger flow taking place later. This is not, however, a matter of any importance, and the surgeon should take no measures to cause the bowels to act; indeed, it is better, as far as the operation is concerned, that the flow be postponed, for within an hour or so, the parts about the wound become sealed with lymph, and thus the risks of extravasation are diminished.

FIG. 260.



Artificial anus after colotomy with the oblique incision.

Amussat originally suggested the *transverse* incision in the loins, and Callisen the *vertical*, the former crossing at right angles the outer border of the quadratus lumborum muscle, the latter running parallel with it. The *oblique* appears to me to be preferable to either, as it gives more room for manipulation when the colon is empty, it takes the line of the nerves and vessels that traverse this part, and lessens the risk of their division; it follows the ordinary integumental fold of a patient when assuming the recumbent posture, and thus favors repair, and seems to tend much towards the prevention of the prolapse of the bowel that is always liable to follow such an operation. Fig. 260 illustrates the line of incision and the appearance of the artificial anus. It was taken from a patient of Sir W. Gull's, æt. 64, that I operated upon in 1869 for vesico-intestinal fistula, and who died five and a half years subsequently (1875) from a ruptured heart. The gentleman followed his avocation without any discomfort.

After the operation a good sedative should be given, such as opium, morphia, or chloral, and the recumbent position maintained, a piece of oiled lint covered with oakum, and kept in place with a soft towel, being the best application.

The sutures may be removed on the fourth or fifth day, according to circumstances, while perfect cleanliness must be observed.

Nutritive food and stimulants may be given within a day or so of the operation, repair, as a rule, going on favorably.

When the wound has cicatrized, the patient may get up, and a pad covered by a folded napkin and fastened on with a lumbar binder, is the best application. The ivory ball or plug that has been recommended, appears to be a useless instrument, and cannot be kept in its place, nor does it prevent the prolapse of the bowel that is said to be so likely to follow the operation.

With the oblique incision this prolapse does not appear to be the cause of any annoyance, since it seems to take place to a very slight extent.

When contraction of the orifice takes place to too great an extent, a sponge tent or short bougie may daily be introduced. I have, however, met with but one case requiring this treatment.

After convalescence, it is well to wash out occasionally the lower portion of the bowel with warm water, as some feces are apt to pass the artificial opening and rest in the rectum, causing irritation. When the anal end is open, it is best to do this through the natural opening, and when closed, through the artificial.

I have now performed this operation thirty-six times: in four for vesico-intestinal fistula, in two for pelvic tumor, in one for fibrous growths in the rectum, and in twenty-nine for stricture of the rectum. One of the cases of vesico-intestinal fistula lived for four months after the operation, and died with suppurating kidneys entirely relieved from all vesical and rectal distress. ('Brit. and For. Rev.,' Jan., 1869.) One lived nearly six years after the operation, and died, æt. 70, from rupture of the heart. The third is now alive, six years after the operation, and enjoying life, suffering indeed very little inconvenience from the artificial anus. ('Clin. Soc.,' 1872.) The patient with pelvic tumor, already noticed, died on the third day from rupture of the tumor. The second was kept alive two months, and died from the disease. The one with fibrous growths in the rectum was operated upon Nov. 14th, 1877, and is now living in comfort.

Of the twenty-nine patients with stricture, cancerous and otherwise, one lived three years after the operation, and one eighteen months, dying from supposed cancer of the liver after a month's illness; two lived ten and three for five months, eight survived the operation from seven to eighteen days, eight died within a week, the operation in the majority of these cases having been undertaken as a last resource. Six were alive when last heard of, two having been operated upon three years previously, two two years, and two within the year. In every case marked relief was afforded to symptoms, and in many, the patients' expressions of gratitude for such were very strong, several having deeply regretted that the operation had not been performed at an earlier period.

In no single case have I ever regretted performing this operation, although in a large number I have wished earnestly that I had had an opportunity of performing it earlier, since in no instance where it was undertaken did it fail to give relief.

In one of the patients colotomized for vesico-intestinal fistula, who is now alive, six years after the operation, urine finds its way, when he is recumbent, out of the lumbar artificial anus, and, in the second case that survived the operation nearly six years, the same complication presented itself. In neither instance, however, was the flow a source of trouble. This flow, however, might have been enough to keep patent that portion of the intestine that existed between the artificial anus and the bladder, and to preserve it from atrophy; such a result of colotomy being clearly possible, Dr. Michael Harris, of Liverpool, having recorded in the 'Liverpool Hospital Reports' for 1874 the particulars of a post-mortem examination where Mr. Hakes had performed colotomy five years previously for vesico-intestinal fistula, in which the descending colon from the artificial anus, together with the sigmoid flexure and rectum as far as the bladder, had become *completely obliterated* and was found to be replaced by a cylindrical mass of fat. The length of this fatty column was about six or seven inches, and in the centre of it was found a fibrous cord of about a line in thickness, but no trace of a canal of any kind could be therein detected.

Curling has performed or recommended the operation in twenty-one cases, and in fourteen the patients survived over periods varying from two to eighteen months. Pollock gives a case where the patient had survived the operation for two and a half years. Allingham has had ten cases: one died within a fortnight of the operation, five lived a few months, one nineteen months, one four and a half years. Two were known to be living for three and four years after the operation.

These results cannot be regarded otherwise than with satisfaction, for it should be remembered that in all these cases the operation was undertaken when life was threatened, and the distress from the local disease was severe and otherwise irremediable. The operation is beneficial in all cases of vesico-intestinal fistula when solid feces flow with the urine; in all cases of stricture of the rectum so soon as the obstruction becomes serious and local distress great; in all other cases of mechanical obstruction to the rectum from pelvic causes, when no less severe measures for relief can be suggested; and, last, but not least, in extensive ulceration of the rectum, cancerous, syphilitic, or simple, when local treatment fails to give relief, and local distress is great, when the general powers are evidently giving way from the local disease quite irrespective of all mechanical obstruction.

In no case, however, should the operation be postponed till the patient's powers are failing, for then the prospects of recovery are greatly lessened and convalescence is often rendered improbable.

By way of summary, therefore, it may be stated that—

Laparotomy is an operation which should be performed in all cases of acute intestinal obstruction due to bands, internal hernia, and intussusception, that do not speedily yield to other treatment.

Colotomy is applicable to cases of obstruction to the large intestine from stricture or the mechanical pressure of tumors.

Enterotomy affords a means of relief for all other cases of intestinal obstruction to which the two former operations are inapplicable.

ON TAPPING THE INTESTINE.

The practice of tapping the intestine with a fine trocar and canula in cases of intestinal obstruction, is one which deserves serious consideration, since there is good reason to believe, that a small puncture may often be made into a distended intestine and wind drawn off without any extravasation of the contents of the bowel taking place; and that if the distension of the strangulated, twisted, or otherwise obstructed bowel can be relieved by the operation, there is some ground for hope that natural efforts may then release the bowel from beneath its band or from some internal peritoneal ring, and that even a twisted bowel may untwist. The operation, however, is not without its risk, as I have on several occasions known fecal extravasation to follow the practice, and Coupland and Morris quote other cases. I have been also led to believe that even in a large hernia, its strangulation might be relieved by a like operation and a natural reduction take place; for a strangulated bowel, outside as well as inside the abdominal cavity, is strangulated by the distension of the intestine itself, more than from any extra-intestinal influence, and if this distension can be relieved by simply drawing off the contents of the bowel by means of a very fine trocar and canula, the walls of the intestine would collapse, strangulation cease, and unless adhesions confined the bowel in its position, its return might be looked for by natural efforts. These remarks are based upon the fact, that intestine may be so treated without any extravasation following, and such actually came before me in a case of ileo-colic scrotal hernia, in a gentleman æt. 76, when, to enable me to reduce the bowel, I was driven to puncture the protruding intestine in four or five places, and although much manipulation followed this practice, no extravasation occurred at the time or after, and a rapid recovery ensued without a drop of suppuration. The case occurred in the practice of Mr. Kelson Wright, of Kennington. These remarks are only to be read as suggestions, and more particularly as applied to large umbilical and scrotal herniæ. Since the introduction of the pneumatic aspirator by Dr. Dieulafoy this practice has received much encouragement. For more detailed evidence on the subject of intestinal obstruction and its treatment, the following papers may be referred to:—

Brinton, 'Croonian Lectures,' 1859.—Fagge, 'Guy's Reports,' 1868.—Gay, 'Trans. Lond. Med. Soc.,' 1861–2.—Gorham, 'Guy's Reports,' vol. iii, series 1.—Hinton, 'Association Med. Journal,' 1853.—Smith, 'American Journal of Med. Science,' 1862.—Bryant, 'Med. Times,' 1872.—'A Treatise on the Pneumatic Aspiration of Morbid Fluids,' by Dr. George Dieulafoy, 1873.—Trousseau's 'Clinical Medicine.'—Hutchinson, 'Med. Chir. Trans.,' vol. lvii, 1874.—Coupland and Morris, 'Brit. Med. Journ.,' Jan. 26, 1878.—Bryant, 'Lancet,' May, 1878.—'Clinical Society,' 1878.

ON TAPPING THE ABDOMEN.

Whenever fluid collects in the abdominal cavity so as to interfere with life's functions, the operation of tapping may be called for. It may be for *ascites*, a collection of fluid in the peritoneal cavity; for *ovarian dropsy*, a collection of fluid in a single or in a polycystic tumor; or for *hydatid*, whether hepatic, pelvic, or peritoneal. It may also be called for in *renal* or *splenic* cysts.

It would be out of my province to enter minutely into the diagnosis of all these conditions, as the majority of such cases come under the care of the physician, the surgeon being called in simply to operate. Nevertheless, it may be as well to give some of the leading points of diagnosis, for I need scarcely say that the operating surgeon is not relieved of all responsibility of diagnosis by the fact that a medical mind has charge of the case. The operator, as such, assumes part, at least, of the responsibility of the case as well as of the operation.

Diagnosis.—In a general way it may be asserted, therefore, that *ascites* is the result of a chronic action that has been going on for some time, arising from liver, peritoneal, heart, or renal disease, the abdominal dropsy being one of the results only. The history of the case consequently will be a great help in arriving at a conclusion. The fluid, moreover, will be found to fill the abdominal cavity equally; fluctuation being perceptible across the abdomen, and from before backwards well into the loins, even when the abdomen is resonant. As a rule, the intestines will be found floating upwards, thus giving resonance on percussion, the position of the bowels being influenced by that of the patient.

With the body horizontal, they will give resonance at the umbilicus; with the pelvis depressed, above this point; with the pelvis well raised, resonance may even be detected near the pubes. In almost all these cases the sound over the loins will be dull. On looking at the abdomen the surface will be smooth and the enlargement equal. The subject of diagnosis of ovarian and uterine disease will receive attention in Chapter XXVII.

The operation.—The instruments required for the operation are a moderate-sized trocar and canula; an india-rubber tube about six feet long adapted to a silver-tubular plug that fits the canula when the trocar is removed, a lancet or small scalpel; a pad of lint and a roll of good strapping.

Some surgeons prefer one of the modern instruments by which the india-rubber tube is attached to the canula at right angles, and they are very good; but those I have named are ample.

The patient should be brought to the edge of the bed and placed in the recumbent position, with the shoulders raised; a folded sheet or piece of mackintosh cloth having been previously so arranged as to protect the sheets. A catheter should first be passed, then with the trocar and canula warmed and oiled, and a pail at hand, into which the end of the india-rubber tube is allowed to hang, the surgeon may with a lancet make a small incision through the skin and soft parts, about three inches below the umbilicus, or at any other spot at which the operation is to be performed. He should next introduce the trocar and canula with a direct force and semi-rotatory movement of the wrist, guarding, with his forefinger fixed about one inch from the end of the canula, against inserting the trocar too far. The abdomen having been punctured, the trocar may be removed with the right hand, the canula being pushed further in at the same moment with the thumb, and its orifice plugged at once with the left thumb, to prevent the escape of fluid. The silver plug of the india-rubber tube may then be introduced and the fluid allowed to escape, the distal end of the tube being kept submerged in the fluid in the receptacle; the tube acting as a syphon.

To facilitate the flow and to evacuate the whole contents of the cavity, some surgeons roll the patient over on the side, or place him so at the first; but such a proceeding is unnecessary.

When the fluid has ceased to flow, the canula is to be gently removed, the thumb and finger of the left hand nipping up the soft parts as its end appears, so as to prevent the admission of air into the abdominal cavity, and the trickling of any fluid down the patient. The edges of the wound may then be adapted by a piece of good strapping, and a pad of lint applied when oozing appears, but not otherwise; two or three bands of strapping, three inches wide, should then be adjusted to the front of the abdomen from side to side. Where great hollowness is left, a pad of cotton wool often gives comfort. The old-fashioned flannel bandage may be abolished, as it is only an inconvenience.

All pressure on the abdomen during the flow of the fluid should be avoided as unnecessary, and also all pressure after the operation; support only being required.

The usual place to perform the operation is in the linea alba, about two or three inches below the umbilicus; but in ovarian disease any point in the linea semilunaris may be opened, and in rare cases any other.

When a hydatid, renal or splenic cyst requires to be tapped a small trocar and canula, such as is employed for tapping a hydrocele, should be used; though, in these cases, the Pneumatic Aspirator is of great service, for by its use the fluid can be removed without the possibility of air being introduced.

HYDATID TUMORS

of the liver, spleen, or other parts of the abdomen are occasionally met with, and, however large a size they attain, they rarely produce other symptoms than those mechanically caused by their size, and on that account they may require treatment. Their origin as indicated by their position, although, when situated in the pelvis, there may be an impossibility in diagnosing them from ovarian cysts. They are almost always very globular and tense, and rarely give rise to distinct fluctuation. The external feel of a hydatid is somewhat peculiar and characteristic. In 1868, I removed with permanent success an enormous hydatid tumor from the abdomen, although apparently not from its cavity, of a lady patient of Dr. Oldham, æt. 35, who was believed to have had ovarian disease ('Guy's Hosp. Rep.,' 1868), while Mr. Spencer Wells records a case in which the hydatids were turned out of the abdominal cavity. Sometimes the hydatid dies without surgical interference, and, as a consequence, severe suppuration is set up with violent constitutional disturbance, which requires surgical aid.

Not long since I opened, with marked success, a large abscess over the liver of a boy æt. 17, and evacuated a quantity of pus, bearing the peculiar odor of hydatid pus. The abscess clearly came from the liver, and was a suppurating hydatid. The boy previously had suffered from tape worms. In 1869, I had to open freely a suppurating hydatid tumor, which had half filled the abdomen of a gentleman, æt. 40, who had had it tapped some months before in Australia, and a complete recovery ensued. A quantity of dead hydatid cysts escaped through a large canula that was introduced. The cyst was washed out daily with great benefit. The gentleman is now quite well. I have had at least six other cases in which a like treatment was employed with success, nor have I lost one, although several have had a very narrow escape. The secret of the treatment of suppurating hydatid cysts consists in a free outlet for all purulent and dead hydatid deposits, and the frequent washing out of the suppurating cavity with water containing iodine, Condy's fluid, carbolic acid, or creasote, with or without the introduction of a drainage tube or elastic catheter. For the operation, a large trocar and canula should be employed—the canula being left in for some days until a good opening is established; it may then be exchanged for an elastic catheter or large drainage tube.

Before suppuration takes place, however, other treatment is applicable, such as draining off partially or wholly the fluid contents of the hydatid by means of a very fine trocar and canula. I have performed this operation on many occasions with success, but generally prefer to draw off only a few ounces of the fluid; clinical experience indicating that by this measure alone the hydatid may be killed, subsequently withering up and ceasing to hurt. Dr. J. Miller, of Tasmania, where this disease is frequent, speaks highly of the use of twenty-grain doses of the bromide of potassium three times a day after the tapping, and Dr. Bird, of Melbourne, combines with it drachm doses of the tincture of kamela. At times, also, cases which have been looked upon as cured are not so, and after the lapse of years the disease reappears. When suppuration follows tapping, however, a cure ensues.

The operation of simply tapping a hydatid with even the finest instruments is not, however, free from danger, for in January, 1877, I tapped a man æt. 42, who, with the exception of the hydatid tumor of the liver, was in perfect health, and drew off half a pint of hydatid fluid, having to perforate the structure of the liver to the depth of an inch to reach the cyst. The operation was not attended by the slightest distress; but on the removal of the needle an agonizing pain attacked the man's face and jaws, accompanied with flushing of the head and neck. This was followed by vomiting, extreme pallor, and stertorous breathing for a minute, followed by death in two minutes. At the necropsy nothing was found to account for this sudden end, that is, there was no embolism or heart trouble, no brain disease, nothing but a large hydatid cyst behind the liver. The needle had, however, passed through a misplaced portal vein on its way to the hydatid, and the question arose as to the possibility of death being due to the mixing of the hydatid fluid with the venous blood. No blood was extravasated (Clin. Society, 1878). My colleagues, Dr. Fagge and Mr. Durham, have given us some evidence that a cure can be obtained by electrolytic treatment, on Dr. Althaus's plan of introducing into the tumor two electrolytic needles, one or two inches apart, connected by means of wire to the negative pole of a galvanic battery of ten cells, and completing the current through the tumor by means of a moistened sponge, attached to the positive pole of the battery, applied for ten or more minutes at a time to different points over the swelling. ('Med.-Chir. Trans.,' vol. liv.) This operation may be repeated according to circumstances.

Such treatment may be employed when simple tapping fails to cure. Some of the patients reported as cured by these means have returned, however, with the disease, and it is still a question whether more is gained by this method than by simple puncture and the withdrawal of some of the hydatid fluid.

Further information may be gained from Murchison's work on the liver, 1868, Harley's paper, 'Med.-Chir. Trans.,' vol. xlix, and Dr. Bird, of Melbourne's, book.

Tumors of the Umbilicus.

Pedunculated outgrowths from the umbilicus are not uncommon and always found in children, being composed of simple granulation tissue; indeed it seems probable that they are really due to excess of granulation growth from the point at which the umbilical cord separated. They sometimes attain a large size, and have occasionally a slight central canal or orifice, though the former never travels far. I have seen one the size of the last joint of my little finger. They are easily cured by the application of a ligature to their bases.

These tumors, however, must not be confounded with a condition that is occasionally met with, viz., the presence of a fleshy outgrowth not unlike a glans penis, through which a real canal extends into the bladder, the canal being clearly an open urachus. I have seen only one such case, and recorded it in my Lettsomian lectures on the surgical diseases of children, 1863. I wished to cauterize the surface of the canal and thus cause its contraction and closure, but was not allowed.

I have also seen a large hernial protrusion appear at the umbilicus, with the whole surface ulcerated, in which there were some solid contents which I took to be the liver. It subsequently completely cicatrized and a good recovery ensued. The drawing of this case is in Guy's Hospital Museum (*vide* Fig. 284).

Sebaceous tumors, as well as accumulations of sebaceous matter are also met with at the umbilicus in dirty people. I have turned out large masses of such indurated secretion from the cup-like depression.

Cancerous tumors, &c., as well as simple warty growths and syphilitic condylomata, may also exist in the same position.

CHAPTER XV.

HERNIA.

DIAGRAMS ILLUSTRATING THE DIFFERENT FORMS OF HERNIA, WITH SOME OF ITS COMPLICATIONS.

In all these diagrams the thick black line represents the parietes covering in the hernial sac; the thin line the peritoneum and hernial sac; the small body at the bottom of the sac the testicle.

FIG. 261.

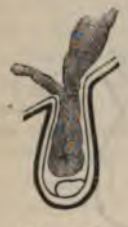


Fig. 261.—This diagram illustrates the tubular vaginal process of peritoneum open down to the testicle, into which a hernia may descend. When the descent occurs at birth the hernia is called "congenital;" when at a later period of life the "congenital form," Birkett's "hernia into the vaginal process of peritoneum," or "Malgaigne's hernia of infancy."

FIG. 262.

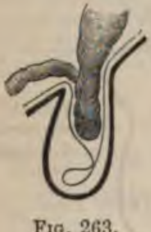


Fig. 262.—The same process of peritoneum open half way down the cord, into which a hernia may descend at birth or at a later period. Birkett's "hernia into the funicular portion of the vaginal process of the peritoneum."

FIG. 263.

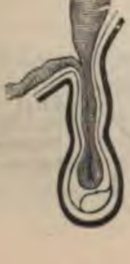


Fig. 263.—The same process undergoing natural contraction above the testicle, explaining the hour-glass contraction met with in the congenital form of scrotal hernia as well as in hydrocele.

FIG. 264.

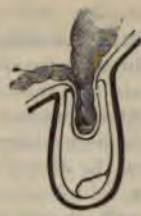


Fig. 264.—Diagram showing the formation of the "acquired congenital form of hernia," the "encysted of Sir A. Cooper," "the infantile of Hey," the acquired hernial sac being pushed into the open tunica vaginalis which incloses it.

FIG. 265.

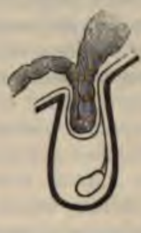
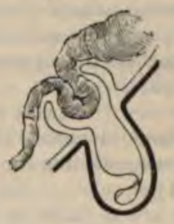


Fig. 265.—Diagram illustrating the formation of the "acquired" hernial sac, distinct from the testicle or vaginal process of peritoneum which has closed.

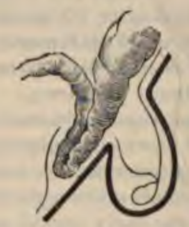
FIG. 266.



Second variety of displaced hernia.

Fig. 266.—Illustrates the neck of the hernial sac pushed back beneath the abdominal parietes with the strangulated bowel. (*Vide* Fig. 279.)

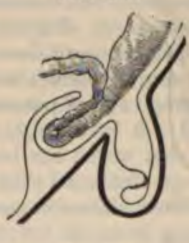
FIG. 267.



Third variety of displaced hernia.

Fig. 267.—Shows the space in the subperitoneal connective tissue into which intestine may be pushed through a rupture in the neck of the hernial sac; the intestine being still strangulated by the neck. (*Vide* Fig. 280.)

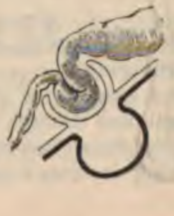
FIG. 268.



Fourth variety of displaced hernia.

Fig. 268.—Diagram showing how the neck of the vaginal process may be so stretched into a sac placed between the tissues of the abdominal walls either upwards or downwards between the skin and muscles—muscles themselves or between the muscles and the internal abdominal fascia—forming the intra-parietal, inter-muscular, or interstitial sac; hernia *en bissac* of the French; "additional sac" of Birkett. (*Vide* Fig. 281.)

FIG. 269.



First variety of displaced hernia.

Fig. 269.—Diagram illustrating the reduction of the sac of a femoral hernia *en masse* with the strangulated intestine.

ABDOMINAL HERNIA.

Abdominal hernia or rupture signifies the protrusion of any viscus through an opening in the parietes of the abdominal cavity. This protrusion for the most part occurs at the *inguinal* and *femoral* canals or *umbilicus*, though, occasionally, at other parts where the abdominal walls have been weakened by some inflammatory lesion, rupture, or division of muscle from injury or operation, and more rarely at such weak points of the abdominal walls as the obturator foramen, the perineum, the ischiatic notch, the diaphragm, or the vagina.

It is met with in subjects of every social condition, but most frequently amongst the so-called working classes; and, probably, as Mr. Kingdon informs us in his excellent paper on hernia ('Med.-Chir. Trans.,' 1864) because "hernia occurs oftenest in the most numerous classes, and not in the most laborious."

Hereditary predisposition to hernia is also doubtless a reality; a third of all cases acknowledging a history of having a ruptured parent; such predisposition probably existing as a general laxity of the mesenteric folds and parietal layer of peritoneum. I have been called upon to operate on an old gentleman, the male branches of whose family for four generations—twelve in all—have been ruptured. Inguinal hernia is often due to a failure in the natural closure of the sheath of peritoneum that travels down with the descending testicle, which failure is more common on the right side.

Subjects who are congenitally feeble, and others who become weak from illness or old age, are more liable to hernia than the robust, the weakness of the abdominal parietes yielding to the natural pressure of the abdominal contents under the influence of some sudden or prolonged muscular exertion. Although a large number of the cases of hernia are slow in their development, many are sudden, and in all, muscular exertion plays an important part.

Out of every 100 cases of hernia, 84 are *inguinal*, 10 *femoral*, and 5 *umbilical*. It is more common in males than females, in the proportion of 4 to 1; 18,492 females only having been applicants for trusses at the Truss Society, out of the total of 96,886 ('Report,' 1871).

Females are as liable to inguinal hernia as they are to femoral, the inguinal being most common in early life from the canal of Nuck being open; the femoral in middle and old age. In females under 20 years of age there are 87 cases of inguinal hernia to 13 of femoral; and after 40 years there are 32 cases of inguinal to 68 of femoral. The largest number of cases of femoral hernia are developed during the child-bearing period of a woman's life, that is, between 20 and 40 years of age. Prior to menstruation it is so rare as to be almost unknown. Kingdon gives only four such cases.

In males, *inguinal* hernia is the usual form, Kingdon's table showing that the largest number of cases occur during the first ten years of life, in consequence of the vaginal process of peritoneum that covers the spermatic cord being still open. It is about half as frequent between the ages of 10 and 20 years, while between 20 and 40 it is as common as it is at the early period of life, but its frequency rapidly diminishes after that period.

Femoral hernia occurs in the male about 4 in every 100, though it becomes, as in the female, relatively more common than inguinal as age advances. During the first ten years of life it is not met with more frequently than 1 in 300; whilst between the ages of 10 and 20, 2 per cent. are femoral; between 21 and 40, 4½ per cent.; between 41 and 60, 6 per cent.; and above 60, nearly 8 per cent.

The average age of persons suffering from *strangulated inguinal* hernia is 43, but from femoral 55. A hernia that becomes strangulated in its first descent is far more acute and fatal than that which has been of long standing, and a femoral hernia is more liable to become so strangulated than an inguinal in the proportion of 3 to 1. These "recent cases" of femoral hernia mostly occur in old women about 60 years of age, and of inguinal in young men, the hernia being in the latter of the "congenital kind."

Anatomy of a Hernia.

A *hernial tumor*, with few exceptions, is composed of a *sac* with its *contents* and the soft parts covering it.

The *sac* is made up of peritoneum, is formed by the gradual stretching and pouching of this membrane through an opening in the abdominal parietes by the protruding viscera, and, being artificial, has been well named by Birkett the *acquired hernial sac*; this term distinguishing it from a second form—equally well named—the *congenital hernial sac*, which is only found in inguinal hernia, being composed of the vaginal tubular process of peritoneum formed by the descent of the testicle—the opening that normally exists in fœtal life not having closed owing to some deficiency in the obliterating process that naturally commences at the internal ring and proceeds downwards towards the testis in the scrotum.

The formation of the hernia in the former case is a gradual, but in the latter a rapid process, the "acquired" hernia being an affection of middle and old age, the "congenital form" one of infancy or young adult life.

The sac also is composed of a body and a neck, which communicates by a mouth with the abdominal cavity. When the hernia is small, the neck and body appear as a small pouch, into and out of which the hernial contents pass with facility; the sac having no narrow neck by which the return of the intestine can be retarded. But when the hernial sac is large, and has escaped into looser tissues, its body or fundus so expands as to render by comparison the neck of the sac a narrow canal or orifice, the return of the hernial contents often becomes one of difficulty, and under these circumstances it frequently becomes strangulated.

The neck of the sac also undergoes changes which it is essential to understand, particularly in cases of scrotal hernia, where the peritoneum is so forced outwards through the inguinal ring as to fall into puckered folds.

These folds will disappear, however, if the hernia and sac be reduced into the abdominal cavity or the constricting ring of tissue external to it be divided, the degree of unfolding of the neck of the sac being regulated by the amount of expansion of which it is capable. But should the sac be neither returned nor its constricting ring of outside tissue divided, the puckered folds of peritoneum will adhere, and probably the subperitoneal connective tissue will unite with it; the neck of the sac, under these circumstances, becoming indurated and thickened, and in an old inguinal hernia having an independent existence, requiring special treatment in operation.

This thickening, moreover, as time progresses, is followed by contraction, and as a consequence a narrowing and rigidity of the neck of the sac, which necessitates in old inguinal hernia, when an operation for strangulation is required, the opening of the sac and a free division of its neck.

When a hernia forms at the seat of a wound in the abdominal wall there is no sac, and the same occurs when the cæcum or colon protrudes through the inguinal canal.

The *contents* of a hernia are usually small intestine and omentum, a portion of the last two feet of ileum being, as a rule, involved; the cæcum and colon also are occasionally so, and cases are on record in which the bladder, stomach, or ovary has been found in the sac.

At times the omentum is so pushed before the intestine as to cover it completely, thus forming an inner sac; the bowel, as a rule, being behind the omentum.

When intestine protrudes, the hernia is called an *enterocele;* when omentum, *epiplocele;* when both intestine and omentum occupy the sac, *entero-epiplocele;* when bladder, *cystocele;* when stomach, *gastrocele*, &c., &c.

The tissues that cover in a hernial sac will necessarily depend upon the seat of the hernia. Thus, in the *umbilical*, it may be only the membrane of the cord, skin, and abdominal fascia; in the *scrotal* it will be the scrotal tissues; in the *femoral*, the skin with the superficial and deep fasciæ; but in all, and more particularly in the femoral, the surgeon should bear in mind the anatomical fact, that a layer of fascia—which lines the abdominal muscles and separates them from the peritoneum—covers in the true peritoneal sac, and is known as the "fascia propria" of Sir A. Cooper, and between this fascia and sac some subperitoneal fat often exists.

When a hernia comes down into a sac and goes up again, either by itself or aided by position or by the surgeon, it is called *reducible;* when it cannot be returned it is called *irreducible;* when it is constricted sufficiently to interfere with the return of the contents of the protruding viscera it is known as *incarcerated*, and when in addition the circulation of the part is interfered with, it is said to be *strangulated.*

When the protrusion takes place *above* Poupart's ligament, through the internal ring, but does not traverse the canal sufficiently far to appear through the external, the hernia is called a *bubonocele* (*vide* right side of Fig. 270); when it protrudes through the external ring into the scrotum, a *scrotal hernia* (*vide* left side of Fig. 270), both forms being included in the term *oblique inguinal hernia.*

When a hernia makes its way directly through the external ring without having passed down the inguinal canal, it it called a *direct inguinal* (Fig. 271).

ABDOMINAL HERNIA.

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mposed of omentum and intestine, any accumulation of
the hernial sac may give rise to obstruction, and with
n is not distant. An irreducible hernia, moreover, is

n femoral hernia will sometimes attain a large size. I have seen examples of both reaching half way down the thigh, but umbilical hernia will sometimes attain a still greater size.

These forms of hernia also often give rise to dyspeptic symptoms, to irregularity of bowels and colicky pains, but the chief danger lies in their tendency to become strangulated.

TREATMENT.—A large irreducible *entero-epiplocele* must be treated by a bag truss; that is, with an instrument so adapted as to support the hernia, and prevent as far as possible its increase. A small irreducible hernia ought to be treated by a hollow truss. An *omental* hernia may be treated by a truss, the pad being made of such a shape as to adapt itself to the neck of the tumor, and of such a substance as to seal the orifice of the sac without causing pain; air, sand, or india-rubber being probably the best material for pads. Every patient with such a hernia should be warned against taking violent exercise, or over-distending the abdominal viscera. The bowels should never be allowed to become constipated, and, above all, the slightest symptom of pain or increase of size in the tumor should be brought at once under medical advice, since these irreducible herniæ are treacherous things, and become obstructed and strangulated very insidiously.

In some cases of irreducible hernia, reduction may be effected by rest in the horizontal posture, a brisk purge or enema, and the administration of small doses of saline purgatives, such as the sulphate of magnesia, so as to keep up a gentle action of the bowels, with the *local application of ice*, the diet being at the same time nutritious, though not of a bulky nature. The late Mr. Bransby Cooper gave small doses of blue pill and tartar emetic, but I have not found such remedies necessary. In this way, in a boy, æt. 16, after a month's treatment, I have procured the reduction of a scrotal hernia that had been down three months; and an equally good result in the case of a gentleman, æt. 36, after three weeks' treatment, where both locally and generally, much disturbance existed. Old irreducible herniæ are rarely made reducible by treatment, but the recent can generally be reduced by the means already indicated.

OBSTRUCTED HERNIA.

The *symptoms of an obstructed hernia* as of obstructed intestine are not very definite, but the chief are, obscure abdominal pains with a dragging sensation about the umbilicus after food, nausea, and, at times vomiting. Constipation, when present, aggravates the symptoms, and renders the *local signs* of obstructed hernia more marked, the tumor becoming distended, tympanitic, and painful. On manipulation, the intestine in the hernia may be partially or wholly emptied of its gaseous if not of its solid contents, and the compression of the tumor be accompanied by the peculiar gurgling sound of gas and fluid as these traverse the canal towards the abdominal cavity. When such symptoms are chronic, they are generally known as indicating an *incarcerated hernia*, but such a term is not satisfactory, it being applied to the obstructed as well as to the irreducible hernia, and should be discontinued.

TREATMENT.—These cases require great care in their treatment, because if neglected, they pass on rapidly to inflammation or strangulation. *Rest* in the horizontal position is of primary importance, and the tumor if scrotal should be slightly elevated. *Warmth* to the hernia, also, often gives comfort, relaxing the parts, and thus favoring reduction.

When constipation *unaccompanied by vomiting* exists, a brisk purge may be given, but with this symptom a purgative enema is to be preferred, the natural action of the bowels being stimulated by these means, and the contents of the hernial sac moved on. The tumor itself should not be manipulated at this stage of the case, such a step doing harm by bruising or setting up inflammatory action. When success does not attend these efforts and the symptoms persist, the source of obstruction will have to be sought by the surgeon as it will probably be mechanical, and the case have to be dealt with as one of strangulated hernia.

INFLAMMATION OF A HERNIA.

An inflamed is not a strangulated hernia. Inflammation of a hernia is generally th result of some injury to an irreducible hernia, either from accident, a badly fitting trus or ill-advised manipulation, though an irreducible hernia after an attack of obstructi may inflame. A reducible hernia becoming temporarily irreducible and inflaming, m become permanently irreducible, adhesions forming within the sac between it and

The local *signs* of an inflamed hernia are pain, swelling, and induration. When the tumor contains omentum, it becomes nodulated and irregularly hard; and when intestine, much fluid will be poured into the sac. When the action is enough to interfere with the natural function of the tube, symptoms of general peritonitis or obstruction will appear which must be dealt with on ordinary principles.

TREATMENT.—*Rest* and the *local application of ice* in a bag are the most important remedies, also *purgatives* when obstruction in the hernia does not exist, and opium when it does. By such means, the symptoms are generally arrested; and, when this result does not take place, the case passes on to one of obstruction, if not of general peritonitis.

INTESTINAL OBSTRUCTION AND PERITONITIS AS A RESULT OF THE ADHESION OF A PIECE OF INTESTINE TO THE HERNIAL SAC.

I published such a case in 1861, in part iii of my 'Clinical Surgery,' and Mr. Birkett, in his excellent article in 'Holmes's Surgery,' vol. iv, 1870, has given a second case with a drawing, which I also had the advantage of seeing, and he alludes to the fact that M. Littrè called the attention of the profession to the cases illustrated by the above in a paper, "Sur un nouvelle espèce de Hernie," 'Mém. de l'Acad. Royale des Sciences,' 1700, p. 300. The notes of my case are as follows:—

Umbilical hernia; obstruction to the bowels from a sacculated adherent colon; death.—A woman, æt. 56, having had a hernia for many years, was suddenly seized some twenty-four hours before her admission into Guy's, under the care of Mr. Cock, with symptoms of strangulation. The taxis, under the influence of chloroform, proved successful, but collapse and death followed in twelve hours. After death, general peritonitis was found to have been present; the intestinal coils being all adherent. An umbililical omental hernia, the size of a fist, existed, the omentum forming a distinct sac. To the centre of this the anterior wall of the transverse colon was firmly adherent, forming a kind of pouch. The colon was, however, tolerably free. The intestines above this point were distended, and below it contracted and empty. The cæcum was of an enormous size, almost filling the lower part of the abdomen. It was here that the tension had been experienced; it was black, and in places the peritoneal coat was fissured, leading to the belief that but little extra distension could have been borne without a rupture taking place. The mucous membrane was also lacerated transversely, while the walls were so thin that they were nearly ruptured in handling, these conditions being such as we commonly meet with in cases of chronic intestinal obstruction.

In this interesting case, death had doubtless been caused by peritonitis, although not from the strangulation of the umbilical hernia, but from a partially ruptured and over-distended cæcum; a condition of bowel which had apparently been produced by the traction exerted upon the transverse colon, the result of the adhesion of its walls to the omental sac.

As elucidating a secondary result of hernia, this case must be regarded as most valuable; illustrating, as it does, a point not perhaps sufficiently recognized, namely, the influence of the adhesion of the bowel to a hernial sac, or the abdominal walls upon the functions of the intestines; since doubtless such adhesions are sufficient to account for many of the griping and painful symptoms which exist in an old and irreducible hernia. The case referred to must also be regarded as a good illustration of the result of a long-continued interference with the bowel's action; for the over-distension of the cæcum, with its attendant consequences, was apparently due entirely to the interference with its functions, resulting from the union of the walls of the transverse colon with the omental sac. The calibre of the colon itself was not materially diminished, but its power of acting had become paralyzed; the greater the distension of the intestine above, the greater must have been the traction caused by the adhesion, and as a sequel, the greater was the effect of this interference. At last complete paralysis of the part had taken place, and complete obstruction, giving rise to all the symptoms and conditions which had terminated in death.

These cases tend to prove that the smallest traction of a portion of the calibre of the intestine in a hernia, or otherwise, although accompanied with an open passage of the bowel, is quite sufficient to interfere with the bowel's action, and at last even to cause complete obstruction. In a former page I have pointed out how strangulation of the bowel within the abdomen may result from the formation of bands associated with an external hernia.

STRANGULATED HERNIA.

Whenever a knuckle of intestine slips through an opening in the abdominal walls (external hernia) or is constricted within the abdominal cavity (internal hernia) it is liable to become strangulated, and this result takes place when air or motion enters the upper extremity of the knuckle and distends it so as to compress its lower end against the neck of the constricting orifice through which it may have passed. Under these circumstances, the greater the pressure from above, the more the lower end of the bowel will be compressed, the more complete will be the obstruction, and the sooner the compressed or strangulated bowel will lose its life.

A rupture is said to be strangulated when its solid contents are so constricted as to be irreducible, and the vascular circulation of the parts is more or less completely arrested.

This may happen in its first descent, "*recent hernia*," but more commonly it takes place after a hernia has existed for many years, *old hernia*. An analysis of cases that I made in 1856 ('Guy's Reports') indicated that the average duration of an *inguinal* hernia previous to its becoming strangulated was twenty, and of a *femoral* eleven years. The same analysis likewise showed, that it was a rare occurrence for an inguinal hernia to become strangulated in its first descent; and then when this occurred the *hernia* (recent) is generally of the "congenital" and not the "acquired" kind. Also, that femoral hernia was far more liable than inguinal to strangulation, and also to strangulation on its first descent.

"Recent" strangulated hernia, that is, hernia strangulated on its first descent, both of the inguinal and femoral forms, requires operation more frequently than the "old" hernia, and is far more fatal.

It was also shown that *umbilical* hernia is less liable to strangulation than either of the two other forms, that it is little liable to strangulation in its first descent, and, that when strangulated it is almost always of very long standing.

The symptoms of strangulated hernia are those of obstruction. In "*old inguinal hernia*" of many years' standing they are usually *chronic;* in "*recent hernia*," and more particularly of the femoral form, they are *acute.*

It thus often happens that in an acute or "recent" hernia, inguinal or femoral, its descent is accompanied by severe abdominal pain in the region of the umbilicus, more or less collapse, vomiting first of the contents of the stomach, then of those of the duodenum (biliary vomiting), and, at a later stage, of the yellow contents of the small intestine and even of feces. Constipation is also usually present, although on the first onset of the symptoms, it is not uncommon for the large intestines to empty themselves. With these general symptoms of obstruction, the local signs of hernia will be present at one or other of the sites at which a hernia may occur, the hernial tumor will be tense and painful, and without impulse on the patient coughing.

The general symptoms thus described are common to every form of acute intestinal obstruction whether outside the abdominal cavity from a hernia, or inside from internal strangulation, ileus, or other cause; but, in every case in which they occur, the practitioner should carefully examine the site of every possible hernia, and not trust to the patient in any way, as the local are often masked by the severity of the general symptoms, and the local cause thereby overlooked.

The symptoms in an "old hernia" are less acute, and are those of chronic obstruction. They are not, however, less characteristic *when vomiting has set in;* but in all probability before this symptom appears the patient will have complained of some general abdominal uneasiness, such as flatulence, a feeling of faintness, nausea, and fulness, with local pain in the hernia; the nausea, however, will soon be followed by persistent eructations, hiccough, and vomiting; in most of the cases constipation too will be present, though in some the desire to go to stool will be great and the straining severe. The local signs of strangulation or obstruction are often so slight as to be disregarded by the patient, and unless the hernia is discovered by the surgeon, his attention will probably not be drawn to it by the sufferer. Thus, at Christmas, 1870, I reduced a femoral hernia by the taxis, strangulated for a hundred hours in a man who was unconscious of its presence till a few hours before.

If the obstruction remain unrelieved the powers of the patient will probably become prostrate, and more or less complete collapse will show itself, with a feeble pulse and cold clammy skin. The vomiting also may diminish in intensity or even cease, at times remaining only as a passive pouring out through the mouth of the intestinal contents. Pain previously severe may also suddenly disappear. The collapse, indeed, may be so great that the parts about the neck of the sac become relaxed, and the hernia may go up either by itself, or by the gentlest pressure. Now, such symptoms indicate a serious collapse of the general power of the patient as well as a destruction of the parts strangulated in the hernia, since the reduction of the hernia is too often followed by a fatal collapse, death being usually, under the circumstances, the result of the shock to the nervous system from the severity or persistence of the symptoms. It may, however, occur from other causes, such as gangrene or death of the strangulated bowel, rupture of the bowel at the line of stricture, fecal extravasation, or peritonitis.

When gangrene of the bowel is the cause of death, the collapse may be as great as it is from shock, although of greater duration. Death, however, is slower.

When rupture of the bowel with fecal extravasation is followed by collapse, it will have been preceded by symptoms of local or general peritonitis, or by a sudden severe abdominal pain; for in all cases of strangulated hernia, in which any delay in reduction has taken place, symptoms of inflammation of the protruded parts, of local peritonitis, around the neck of the sac, and subsequently of general peritonitis, will be sure to show themselves.

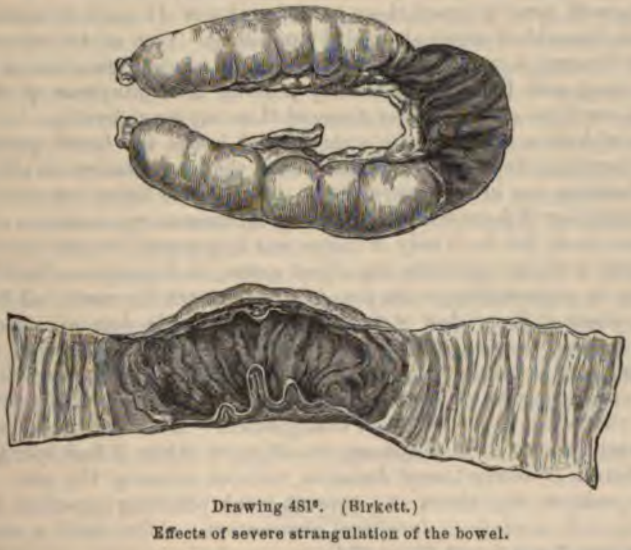
Strangulated omental hernia is characterized by the same symptoms as the intestinal, though less marked and acute. The pain is not so severe, nor the vomiting so constant, constipation is less complete and insuperable, while the constitutional symptoms are also milder. The local distress is likewise inconsiderable, the tumor feeling harder, more nodular, and like to an obstructed hernia, permitting manipulation more freely than when it contains intestine. As time progresses, however, symptoms of inflammation in the hernial tumor will show themselves with those of local peritonitis, and when these appear, they are as severe and destructive as they are in other forms of strangulated hernia. In exceptional cases, however, the omentum may slough.

A strangulated omental hernia requires, consequently, as active surgical treatment, as any other, as it leads to the same end—a fatal peritonitis.

PATHOLOGICAL CHANGES, THE RESULT OF STRANGULATION.

These are the same when they take place within the abdominal cavity as in an external hernia, and under both circumstances, the first effect of the *partial* arrest of the circulation through the parts is congestion—this congestion being associated with its usual accompaniment, *serous effusion.* When *complete* arrest has taken place the congestion will be more thorough, the surface of the bowel appearing of a red purple or blackish hue, and the tissues themselves thickened from effusion into their meshes or blackened, wholly or in spots, by extravasated blood (Fig. 273). When they have been much manipulated by the "taxis," the extravasation of blood into the tissues is often very marked, the degree of congestion depending upon the intensity of the strangulation.

FIG. 273.



Drawing 481⁸. (Birkett.)
Effects of severe strangulation of the bowel.

When, however, the strangulation has been acute or of long standing, and an inflammatory action been added to that of congestion, the bowel will not only be swollen but soft, the natural glistening aspect and elasticity of its coats having become changed for a dull appearance and leathery condition. Its serous surface may indeed be covered with a layer or with flocculi of lymph, or the knuckle of intestine may be wholly or in part soft and gangrenous, with ash-colored spots on its surface, and even perforations.

At the neck of the sac other changes will also be found, and these depend materially upon the character and seat of the constricting force. Thus, when the line of a strangulation is rigid and linear, as it is in direct inguinal and femoral hernia, the knuckle of strangulated bowel, either as a whole or in part, may be rapidly destroyed by gangrene. And when the pressure is more diffused and less rapid, as in large inguinal hernia, ulceration of the mucous membrane at the line of stricture, even to perforation, is more common—the grooved or sulcated condition of the serous surface in the line of stricture being found in both.

Within the abdomen every indication of peritonitis from the mere greasy condition of peritoneum to fibrinous or even suppurative effusion may be met with. In most cases local peritonitis will be found about the seat of hernia, and in some the peritonitis will be general. The strangulated portion of bowel will almost always be found at the neck of the sac, if not adherent to it, with more or less matting together of the neighboring coils.

That this peritonitis is to be directly attributed to the strangulation of the intestine is generally acknowledged, few cases of strangulated hernia remaining long unrelieved without local or general peritonitis making its appearance. It is also indisputable that this peritonitis is often aggravated, and at times caused by the reduction of the inflamed and injured contents of the hernial sac into the abdominal cavity; but to assert with Mr. Hutchinson and M. Girard, that in the bulk of cases it is the return of the intestine into the abdomen that gives rise to the peritonitis, is an assumption which facts hitherto known do not bear out.

When the intestine has sloughed wholly or in part and discharged itself through the wound, an artificial anus is said to exist. This result is far more common after femoral than inguinal hernia.

When the bowel subsequently ulcerates after its reduction, either at the line of stricture as it may in inguinal hernia, or, at the centre of the knuckle as is the more common in femoral hernia, extravasation of feces may take place, half of these cases of extravasation being either general into the peritoneal cavity and fatal, or local about the neck of the sac.

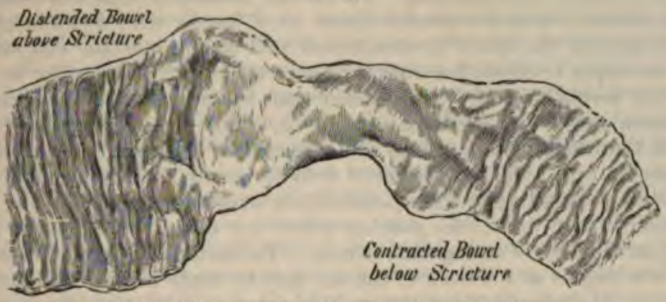
The following facts, published by me in 'Guy's Hosp. Rep.,' 1856, on the causes of death in hernia, will tend to prove these points. Out of 17 cases of artificial anus after hernia, 13 were femoral, 3 inguinal, and 1 umbilical. Out of 15 cases of gangrenous bowel, 11 were femoral, 4 inguinal. Hence, out of 32 cases of gangrenous bowel, 24 were femoral, 7 inguinal, and 1 umbilical, clearly proving that *gangrene of the intestine and artificial anus are more common after femoral than inguinal hernia.*

Of 15 cases of hernia in which the strangulated bowel was found perforated, 10 were femoral and 5 inguinal; in 4 the perforation was at the line of stricture, all being inguinal; in 11 the perforation was in the centre of the knuckle, 10 being femoral. In 8 of these 15 cases extravasation of feces was prevented by inflammatory exudation sealing the aperture. In 7 it existed, but in 5 only of these was it general; in the other 2 it was local. Of these 7 cases, in 2 the taxis was the direct cause, in 1 gangrene, both being cases of femoral hernia; in 4 ulceration at the line of stricture was the cause, all being inguinal. *From these facts it is evident "that ulceration in the line of stricture with fecal extravasation is more frequent in inguinal than in femoral hernia, and that when it is found in the latter, it is generally from rupture of the bowel from forcible taxis."*

As a result of a strangulated hernia, I must mention a stricture of the intestine due to contraction of the bowel that had been strangulated. A unique example of which took place in my practice in 1870 in a woman, æt. 52, upon whom I had operated for strangulated femoral hernia of thirty hours' duration, without opening the sac. Convalescence followed the operation, but about the seventh week vomiting appeared, and death took place in the eleventh week from intestinal obstruction. After death a complete stricture of a knuckle of bowel was found (Fig. 274).

The fluid found in the hernial sac varies according to the condition of its contents. In the early period of strangulation, when the contents of the hernia are merely arrested and the circulation impeded, simple serum will be found. When an extreme congestion exists, the serum will be more blood-stained. In even worse examples where blood has been extravasated into the tissues, the fluid will contain blood elements or blood itself. When the hernial contents are inflamed, flakes or flocculi of lymph will be found floating in the dark fluid. When the bowel is gangrenous, fœtor will be observed. When perforation has taken place, feces will be mixed with the fluid, and often gas. When the hernial tumor is red, infiltrated, and emphysematous, the surgeon may safely infer that sphacelus of the gut exists.

Fig. 274.


Distended Bowel above Stricture
Contracted Bowel below Stricture

Stricture of the small intestine after strangulated hernia.

Thus, the condition of the fluid and the external aspect of the sac are valuable aids to diagnosis and prognosis in strangulated hernia.

TREATMENT OF STRANGULATED HERNIA.

When a hernia is strangulated, nothing but its immediate reduction should be entertained, as delay is highly dangerous. In the surgeon, indeed, it is criminal, since every hour of strangulation adds to the risk, which it is his duty to diminish. This can be done by manipulation, or by what is technically called "the taxis," and when this fails, by "the operation" of herniotomy.

To aid the surgeon in the adoption of these means, the use of an anæsthetic cannot be too highly praised, as it contains within itself all the advantages of every other form of treatment without a single disadvantage. It renders the reduction of a hernia by the taxis a gentle, and comparatively simple measure, and, certainly, a far more successful one than of old. It facilitates also the operation of herniotomy on the failure of the taxis. Indeed, in strangulated hernia the value of an anæsthetic is so great that I would urge, where it can be rendered available, that the taxis should never be employed without it, and, that on the reduction of the hernia failing to be accomplished, "the operation" ought to be performed. The warm bath, the administration of opium, the injection of tobacco, the local application of ice, for strangulated hernia being, in comparison, poor and unreliable remedies. In *obstructed* or *inflamed* hernia, however, they are still of use, but in *strangulated* intestinal hernia, recent or old, inguinal, femoral, obturator, or umbilical, chloroform, the taxis, and operation, are the three great means of securing reduction upon which the surgeon ought consecutively to rely. The taxis, however, is not equally successful in every form of strangulated hernia.

In *inguinal* cases, two-thirds at least are reduced by the taxis, a large proportion of these being successfully treated with the patient under the influence of chloroform, when the taxis without chloroform fails. Strangulated old herniæ are also more successfully treated by the taxis than recent cases, which are seldom reduced by this method.

In *femoral* hernia, on the contrary, the taxis is not half so successful as in inguinal, and much more fatal. It is most successful in "recent," whilst in old cases it seldom succeeds.

In *umbilical* hernia two-thirds of the cases are reducible by the taxis.

THE TAXIS.

With the patient under the influence of an anæsthetic and placed on the back, the shoulders raised and the legs partially flexed and rotated inwards—in order to relax all the parts that can possibly affect the neck of the sac—the surgeon should steadily grasp with the fingers and thumb of one hand the neck of the sac, so as to fix it and at the same time to prevent the contents of the sac on being pressed from bulging round the orifice.

Then with the other hand he should raise the tumor, if large, and gently compress it so as to empty it of its serous, gaseous, fecal, or venous contents, and thus lessen its size. Having done this, he should draw the tumor first to one side and then to the other with the view of opening the constricted lower end of the strangulated gut and allowing the contents of the bowel to pass onwards. He should remember that this *cannot* be affected by any direct pressure upon the hernial tumor itself, but it *may be* by lateral; for if the slightest movement of the lower or constricted end of the knuckle can be made in the direction of the upper or distended one, the lower opening will probably be freed and the reduction of the hernia effected by its sudden rush backwards into the abdominal cavity, when the surgeon may be assured that all is well. But when the tumor has diminished in size, and its diminution has not been accompanied by the well-known sensation, a feeling of doubt should ever remain in the mind as to the result, since the want of this symptom of proper reduction should suggest the possibility of a rupture of the bowel, or of a reduction into one or other of the unnatural pouches which are now known to exist under certain circumstances at the neck of an inguinal hernia. To facilitate reduction, a *gentle* kneading movement of the fingers at the neck of the sac may be made in inguinal hernia, as well as a steady traction downwards of the tumor, this traction rendering the neck of the sac a straighter channel for the hernial contents to pass through. With a similar object the sac itself may at times be pinched up with the fingers of one hand and drawn downwards. Violence in manipulation is unjustifiable under all circumstances, and, in proportion to the period of strangulation as indicated by the vomiting, is the danger increased. In femoral hernia also it is comparatively much more injurious than in inguinal, for not only may the bowel be ruptured by forcible taxis (an accident more common in femoral than inguinal hernia) ('Guy's Rep.,' 1856), but it may be so bruised as to be irreparably injured. A preparation and drawing (Fig. 273) in Guy's Museum show such an extravasation of blood into the strangulated bowel of a femoral hernia as to cause its complete death, this being clearly due to forcible taxis.

Where evidence exists that gangrene of the contents of the sac has taken place, or where, indeed, there is a suspicion of such a result, the taxis must not be used. In recent or old femoral hernia, where fecal vomiting has existed for some hours, the taxis is a dangerous practice, and in all old cases it is so unsuccessful that reduction by herniotomy is a more certain and safe method. If there be hiccough, the taxis is inadmissible. The taxis may succeed without chloroform, but, as a rule, with the patient under chloroform, a hernia that is capable of being reduced by the taxis returns on the gentlest manipulation, and, when such a result does not follow, force will not only be unsuccessful, but also prove injurious.

When the taxis succeeds, vomiting usually disappears, although it may be kept up to a slight extent as an effect of the anæsthetic. The abdominal dragging pain will, however, be at once relieved. After the reduction of the hernia, a pad should be carefully adjusted over the neck of the sac to guard against its re-descent, and, when the patient has a cough, the necessity of doing so is increased, as I have known the hernia descend and a renewal of all the symptoms take place from a want of attention to this point; indeed it is wise to adapt a pad till a truss has been obtained. The patient under all circumstances should be kept at rest for a few days after the reduction of a strangulated hernia. The diet, too, should be nutritious but not solid, till the bowels have acted spontaneously, and no aperient under any but exceptional circumstances should be administered, for the bowels will to a certainty act as soon as the effects of their strangulation have passed away, and they have recovered their natural tone. If, however, abdominal symptoms appear which can be attributed to a want of the natural action of the bowel an enema may be given, and repeated with advantage when required. Stimulants should be used with caution. When the bowels have acted naturally the patient may be pronounced convalescent, and the ordinary diet, &c., allowed.

Where chloroform is not at hand, or cannot readily be obtained, a good dose of opium, such as a grain and a half of the solid or thirty drops of the tincture may be given and repeated to an adult, for when a patient with an old hernia is brought fully under the influence of this drug, reduction may often be obtained by manipulation. In the very earliest hours of strangulation, before vomiting has become severe or passed beyond stomach vomiting, this practice is also at times successful. It may be tried moreover when the surgeon cannot obtain the patient's consent to perform herniotomy, and reduction has not been effected by the taxis under chloroform, or when time has necessarily to be lost in making arrangements for operative relief. Under the same circumstances, a *hot bath* (99° F.) may be used. The local application of ice should be employed in *old* cases of hernia where the symptoms are chronic, and delay is a necessity or expedient. In omental hernia also it is particularly valuable, and should be applied over the whole tumor in a loose bag. A purgative is never admissible with a strangulated hernia.

The taxis with inversion of the body, the legs flexed, pelvis raised, and shoulders depressed, has been successful in causing the reduction of a hernia. On a bed, it may be done by pillows placed below the pelvis; but if one of Alderman's chairs or a lithotomy couch is at hand, it may be used. Some surgeons, with the patient in the recumbent position, and a folded sheet placed round the abdomen over the umbilicus, have forcibly drawn the contents of the abdomen upwards. Both these methods are founded on the principle of withdrawing by position and force the contents of the sac into the abdominal cavity. They are *possibly* justifiable when herniotomy is not sanctioned nor chloroform employed, and delay is dangerous. I cannot recommend them.

The taxis should never be employed for any lengthened period. With the patient under chloroform, a femoral hernia of average size (that of a walnut) should never be manipulated for more than two minutes; half that time, or less, is usually sufficient to effect reduction where it is to be secured, while any more prolonged effort will be injurious. The taxis should never be forcible. In large femoral herniæ, inguinal or umbilical, five minutes may possibly be allowed; but the quarter and half hour's manipulation so frequently talked about, is dangerous in the extreme. In very large herniæ, ten minutes may be permitted without chloroform, and periods half as long again may possibly be called for. It is, from this fact, coupled with another, viz., that without chloroform twice the force is needed, that the use of the anæsthetic is to be recommended.

The reduction of a hernia by *gentle* taxis with a patient under chloroform is a simple, rapid, and successful operation. The reduction of a hernia by *forcible* or prolonged taxis without chloroform is a dangerous and far less successful proceeding. In femoral hernia, indeed, herniotomy had far better be employed. Under chloroform, the taxis is almost always successful in inguinal hernia.

When the taxis has failed, nothing but an immediate operation is justifiable. The operation is not of itself dangerous, although the condition that demands it is exceedingly so. It is not, and should not be regarded as a last resource; for in many cases it should be the first. When a patient is hanging, the first thing any one does is to cut the rope that is causing strangulation; and no other means are admissible. When a piece of bowel is strangulated, the strangulating medium requires division to give it freedom; the doing of it adding nothing to the danger of the case. The danger lies in the strangulation which increases every minute.

HERNIOTOMY OR KELOTOMY

remains now to be described, and let it be repeated, *that it is to be performed directly the reduction of a strangulated hernia by the taxis has failed, and, if chloroform is used, while the patient remains under its influence.* To submit a patient to the depressing effects of chloroform to apply the taxis, and, on its failing, to allow any period of time to pass before resorting to herniotomy, is a practice to be condemned—a second administration of chloroform for the operation having no beneficial influence. It would be better for the patient and far better practice to delay the application of the taxis till chloroform can be obtained, and the arrangements for operation made, in case the taxis fails.

The objects of the operation are to liberate the strangulated hernial contents, and, in a general way, to return them into the abdominal cavity, exceptional cases occurring in which it is better practice to leave them in the sac wholly or in part; and others, in which it is impossible to reduce them; but to these points attention will be directed further on.

To liberate the strangulated hernial contents, the cause of the strangulation must be divided; and, as previously shown, this may be found in the tissues outside the sac, in the neck of the sac itself, or in the contents of the sac.

When the cause of constriction is found outside the sac as is usual in femoral hernia, the opening of the sac is rarely needed, division outside being all that is required.

When the neck of the sac is the seat of obstruction and prevents reduction, an opening into it sufficient to allow of its division is all that is necessary. When the difficulty lies in the contents of the sac, the surgeon will be required to lay the whole open, and to expose it in order to its removal. But it should be remembered that the less the contents of a hernia are exposed and consequently manipulated the better are the results; also when all that is desired can be secured by the division of the tissues outside the sac, there is no need of doing more; and that when the division of the neck of the sac allows of the reduction of the hernia, a greater exposure of the contents of the sac is unnecessary and wrong, for in hernia, as in all surgical interference, the surgeon should carry out his objects in the simplest way his art can allow, and should never allow himself to do more than the absolute necessities of the case demand. Meddlesome surgery is always bad, but in hernia is too often fatal.

These remarks, however, are only entirely applicable to cases of strangulated hernia in which the whole contents of the sac are reducible; since when *some portion remains behind*, a feeling of doubt may at times remain as to the thoroughness of the reduction of the strangulated portion or the condition of what is left, and, under these circumstances, it is usually advisable that the sac be opened and explored; yet it is better to do so after the partial reduction of the hernia, when, in all probability, the strangulated bowel has been reduced and is consequently out of harm's way, than with the whole contents of the sac *in situ*, and when they may be exposed. When the *hernia cannot be reduced without opening the sac*, the whole must necessarily be explored. It will thus be seen that the question of opening or not opening the sac resolves itself into the necessities of the individual case. Where reduction can be effected without it, the "minor" operation is sufficient; where reduction cannot be effected by the "minor" the "major" operation must be performed.

The surgeon who opens the sac in *every* case, clearly often does what is unnecessary. He who opens it only when reduction cannot be effected without so doing, or when any uncertainty exists as to the condition of the parts contained in the sac, is free from such an error, "and although we dare not venture to say that some of the fatal cases which have occurred after opening the sac might have terminated differently had it not been incised, we do not hesitate to affirm, that the untoward circumstances stated as likely to happen when the sac is not opened, have not occurred" (Birkett). This view is supported by my analysis of 126 fatal cases of hernia ('Guy's Rep.,' 1856) in which I proved that in no single fatal case could the opening of the sac have had the slightest influence in retarding or preventing the fatal result, as well as by my twenty-two years' experience. The surgeon who advocates the major operation, in most cases will try the taxis, and, I take it, is always well pleased to effect the reduction of a hernia by such means. The operation of herniotomy "external to the hernial sac" differs only from the taxis in the skin wound, yet in what way the necessity for that wound renders the taxis an unsafe measure, it is difficult to conceive. It would be as reasonable to reject the administration of chloroform for the renewed application of the taxis in cases where it had failed to reduce the hernia without its aid, as to say, that because the taxis had failed and a cutting operation is demanded, the ocular inspection and manipulation of the strangulated and therefore already injured bowel is required. To argue that the liberation of a strangulated bowel is not complete until it has been carefully examined, and that moreover without opening the sac, a hernia that is strangulated by omental or other adhesions or by the neck of the sac, may be reduced, are objections which, if applicable at all, are as forcible against the taxis as any operation, and are indeed of little weight.

The operation of herniotomy without opening the sac, has been ably advocated by Petit who first adopted it in 1718, by Munro in 1770, Aston Key in 1833, Luke, and others.

So far as statistics are of value towards the solution of this matter, they are in favor of *not* opening the sac. Thus, out of 59 cases of strangulated femoral hernia operated upon at Guy's Hospital in eight years, in which the sac was *opened*, the mortality was 50 per cent., and, out of 45 cases in which the sac was *not opened* it was only 30 per cent.—the difference between the two classes of cases being 20 per cent. in favor of the minor operation.

Out of 35 cases of inguinal hernia in which the sac *was opened*, 60 per cent. died, and out of 9 in which the sac was not opened, two, or only 22 per cent., died; the difference between the two classes in inguinal hernia being 40 per cent. in favor of *not opening*. But it must be remembered that, as a rule, the cases in which the sac was *not* were of a more favorable kind than those in which it *was* opened.

In umbilical hernia it is a rare thing, however, to save a patient after opening the sac and exposing its contents, though when this is not done, a good result may be looked for.

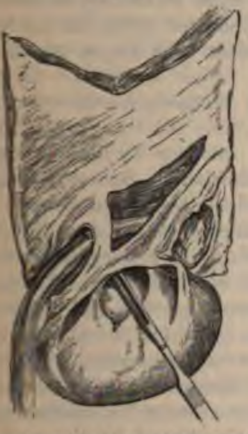
Whenever *the taxis is applicable* to a strangulated hernia and fails, herniotomy without opening the sac is applicable, and, where reduction is effected nothing more is needed. Where reduction cannot be effected, or a doubtful something remains in the sac, where the contents of the sac have not gone back with their normal rush, or the symptoms per-t, and any doubt about the condition of the parts at the neck of the sac is raised, an ploration of the sac and its neck is absolutely necessary.

Whenever *the taxis is inapplicable*, that is, when the strangulation has been of long ration, the symptoms severe, fecal vomiting persistent, and the local as well as gene- symptoms indicate the probability that the strangulated gut has died or is dying; enever, moreover, during the application of the taxis—by the sudden collapse or yield the tumor without its reduction—the fear is excited of some rupture of the bowel ving taken place, herniotomy by the minor operation is inapplicable, and the sac must laid open.

The operation itself.—The patient having been brought under the influence of loroform, should be placed with the shoulders slightly raised, and the knees flexed upon pillow, then the integument over the seat of hernia should be shaved of all hair; an cision can then be made over the neck of the sac, that is, in inguinal hernia, along the ne of the inguinal canal, from the internal to below the external ring; in femoral, over r on the inner side of the crural ring either in a vertical or oblique direction in the course f Poupart's ligament, the former being preferable. In this incision all the soft parts hould be cut through consecutively down to the sac, each layer of tissue being divided he full extent of the wound, while all vessels as they bleed should be twisted.

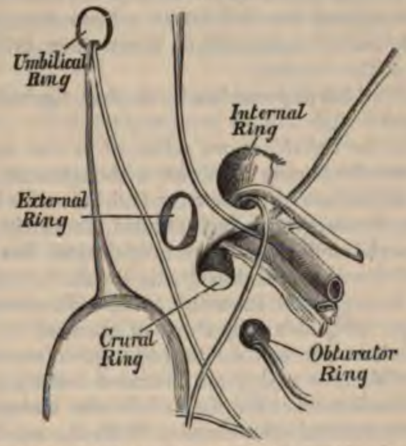
When the sac has been exposed, the seat of stricture outside its neck must be felt for with the index finger, and, when felt, a director may be carefully passed beneath it, Aston Key's director, shown in Fig. 275, being by far the best.

Fig. 275.



Key's director passed beneath the seat of stricture of a strangulated femoral hernia outside the sac beneath the fascia propria. Taken from his work on 'Hernia.'

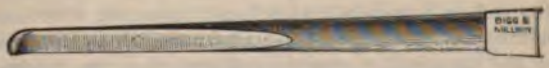
Fig. 276.



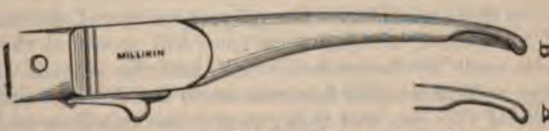
Drawing to illustrate the relative position of all the abdominal rings from within.

With a hernia knife, such as that figured (Fig. 277), straight or curved, or herniotome (Fig. 277), the stricture should then be divided, the incision *upwards* being the safest to avoid the epigastric artery (Fig. 276). This division must not be too free—a quarter of an inch being generally ample in a small hernia. It should, under all circumstances, be only enough to allow of the return of the hernia without force. It is better to have to extend it than to make it too large at first. The stricture having been divided outside the sac, reduction by the gentlest manipulation can then be attempted, and when the contents of the sac go back with a rush, all the surgeon needs has been effected. When no indications of reduction show themselves, or a portion of the contents of the sac has disappeared, but not with the characteristic jerk, or some piece has been left behind, the sac must be opened. To do this, care is needed, the danger of carelessness consisting in wounding the bowel. To

Fig. 277.



Hernia knife.



Herniotome director—A, Blade withdrawn; B, Blade exposed.

avoid this, the sac may be nipped between the thumb and finger, or seized with forceps, and, being slightly raised, opened with a scalpel applied laterally. Through this opening a director should be passed, its point being kept close to the walls upwards towards the neck of the sac, and downwards towards the fundus, the sac being divided upon it with a bistoury of the sac. The escape of fluid usually indicates the opening of the sac, and the character of the fluid the condition of its contents. But fluid does not always run away when the sac is opened, and at other times the escape of fluid from a cyst on the hernial tumor may mislead. The sac having been opened, its contents should be examined, and in doing this the utmost gentleness must be employed. When a *knuckle of intestine* is present, and is neither gangrenous nor perforated, the abdominal cavity is its best place. It may be black from congestion, and spotted from ecchymosis; it may be granular from lymph, or even covered with false membrane; but, as long as it possesses its living resiliency, is not fetid, flaccid, like wet wash-leather, ruptured or perforated, it should be returned.

When a *large quantity of injured intestine* is found in the sac, it had better be left, the surgeon simply relieving the constriction by the division of the cause of stricture, and this ought to be done with the utmost care. The director, when employed, should be kept close to the walls of the sac, and guided by it towards the mouth. Its point should be carefully kept away from the bowel, and not introduced further into the abdominal cavity than to insure the safe division of the stricture, and, when the knife is passed along its groove, the finger of the operator should carefully press the strangulated bowel away from it in order to protect it from injury. The finger, however, is the best director; and should be introduced to the neck of the sac, with the knife upon it, having its side pressed into the pulp of the soft parts. Both having thus reached the neck, the knife may be carefully turned upwards and the tissues divided, the point of the finger measuring the extent of the incision.

When a herniotome such as that figured (Fig. 277), is used, no director need be employed.

When the *intestines are adherent* to the sac or to one another by filamentous or soft adhesions, these may be divided, though such are only met with in recent hernia. The fibrous adhesions of old herniæ had better be left alone, and the hernia considered as irreducible, the surgeon being satisfied, under these circumstances, with dividing the stricture, and thereby relieving the strangulation, but not attempting its reduction. If a fresh piece of bowel comes down, this should be reduced, but the old hernia ought to be left.

The strangulated intestine, under all circumstances, should be handled with extreme delicacy. *Any drawing down of its neck* to examine its condition should be avoided, since such an act can do no good, but often does much harm, in tearing away adhesions that would have sealed an ulcerated orifice, prevented extravasation, and assisted repair. *Any introduction of the finger* into the abdominal cavity is also to be condemned, save under exceptional conditions. With the careful return of the bowel to the neck of the sac, surgical interference ought to cease. The surgeon may satisfy himself that such an end has been obtained without probing the abdominal cavity with his finger, and thus risking life by tearing away adhesions, and undoing in a moment what nature by her own processes had probably been attempting from the first period of strangulation, to shut out from the general abdominal cavity what might prove injurious and dangerous to life.

When the *bowel is dead*, as indicated by its flaccidity and ashy color, all thought of its reduction must be abandoned. The soft parts covering in the sac with the sac itself, should be freely laid open, so as to expose the whole sloughing mass, *and the intestine left to nature*, to pass into what is called an "artificial anus." The neck of the sac may, however, be carefully divided, not, however, with the view of relieving the strangulation, for the gut having become gangrenous, no strangulation exists, but with a view of allowing the intestinal contents to escape when an external opening takes place, and should life be spared, for the subsequent retraction of the bowel towards the abdominal cavity, to effect a natural cure.

No free incision into the gangrenous bowel, no stitching of the intestine to the margin of the wound, is required, as feces will soon find their way through the opening that has been made by the artificial anus, and the surgeon may be certain that within the abdomen, sufficient repair has gone on to fix the intestine that had been strangulated to the neck of the sac, and thus prevent its immediate retraction; for it must be remembered, that as time goes on, this retracting process is precisely that which nature adopts to procure a spotaneous cure of an artificial anus.

When the *bowel is perforated by ulceration or ruptured*, and the opening is not large, the neck of the sac must be incised as in an ordinary case, and the intestine that appears reparable replaced, the perforated or ruptured portion being left at the mouth of the sac. When the rupture or perforation is small, there is no objection to the surgeon placing a ligature round the wound and replacing the gut in the orifice of the sac, for plastic lymph will probably be poured out within a few hours, and the parts sealed from the abdominal cavity.

When *the bowel is in a doubtful condition*, and the surgeon is not certain whether he can say it is irreparably dead, or going to die, the abdominal cavity is still its best place, when it can be returned. Aston Key advocated this plan many years ago, and modern experience has not disproved its value. "The danger of abdominal extravasation will not be increased by replacing the injured bowel at the neck of the sac; for, should sloughing of its coats ensue, the slough may be walled in by adhesion of the surrounding peritoneum and fecal extravasation be prevented." (Key, 'Guy's Rep.,' 1842.)

In an inquiry in 1856 into the causes of death in hernia founded on an analysis of 156 fatal cases, the same conclusion was arrived at. The weight of evidence led me then to express the opinion that there is only one condition of intestine in which its reduction to the neck of the sac is not advantageous, and that is, when it is decidedly ruptured by gangrene or ulceration, my own materials tending to support the opinion of Mr. Aston Key, as stated to the writer in 1849, "that in all conditions of the intestines, the abdomen was their right place."

Mr. Hutchinson, who believes peritonitis to be the direct result of the reduction of an injured bowel into the abdominal cavity, advises in all cases that the damaged gut, if found in a bad condition, should be left in the sac; while Dr. Girard goes further, advising the contents of the hernia, under all circumstances, to be left—the surgeon contenting himself by freely dividing the stricture. I cannot concur in this practice, nor with the principle on which it is based.

When the contents cannot be returned on account of adhesions, the neck of the sac should be incised and the case left to nature. In large umbilical herniæ also, this practice is valuable.

When omentum is found in the sac with intestine, and has only *recently* descended, it may be returned. When it has been down for some time, is irreducible, and is only a small piece, it should be left alone; the omentum, doubtless, often acting as a plug to the orifice of the sac. When it is diseased or in large quantities, it should be ligatured in two or more portions and cut off—the ligatures being applied as near to the neck of the sac as possible, care being observed not to disturb the parts at the neck.

Simply to cut off the omentum and to tie or twist the vessels is risky, the omentum always being highly vascular, and small vessels being apt to bleed much; indeed, cases are on record in which a fatal hemorrhage supervened after this practice. When diseased omentum is left in the sac, prolonged suppuration often follows. Whenever intestine and omentum are found together in a hernia, much care is required. The intestine is generally to be sought for behind the omentum, but is often wrapped up in it, and, in not a few cases, covered by an omental sac. Under all these circumstances, the intestine should be exposed and carefully reduced, care being taken that no adhesions at the neck of the sac or no bands bind the bowel down to the omentum thereby keeping up the strangulation. An omental sac is on no account to be returned into the abdomen unopened. Omental sacs are generally found in femoral hernia. An interesting paper by Mr. Prescott Hewitt ('Med.-Chir. Trans.,' 1844) may be referred to on this subject.

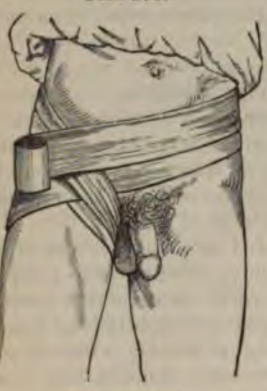
After-treatment.—When a hernia has been returned into the abdominal cavity, the more the case is left to nature the better. As a matter of precaution after the operation, as after its reduction by the taxis when the wound has been brought together with strapping or suture, a pad may be adjusted over the part with a spica bandage (Fig. 278).

A suppository of half a grain of morphia or more should be at once introduced into the rectum, and repeated in an hour should pain render it necessary; a little ice, too, may be allowed for the patient to suck, when thirst is great, but the less that is taken by the mouth the better. When the powers are very feeble, brandy, soda-water, and ice may be given in small quantities.

If no chloroform sickness complicate the case after the first twelve hours, beef tea, arrowroot, or milk, may be given, a pint or a pint and a half in the twenty-four hours being ample. Stimulants should be allowed as the powers of the patient indicate, but always with caution.

On the second day the wound should be dressed, water dressing being all that is usually required, the lower end of the wound being left open for the escape of discharge. Should pain continue and symptoms of peritonitis appear, the opium or morphia suppositories can be repeated twice a day or more frequently; indeed, the patient should be kept under the gentle influence of opium till the symptoms are relieved; hot fomentations should also be applied to the abdomen. Purgatives ought never to be given if the bowel has been bruised or otherwise injured by its strangulation, for as soon as it has recovered its tone, its natural action will return, any goading of it to action by medicine doing much harm. "A bruised bowel," says Aston Key ('Guy's Rep.,' 1842), "is placed by nature in a state of rest; the exhaustion of the nervous energy of the part diminishes in the muscular tissue the disposition to contract. *Such inactivity of the bowel should be encouraged and not thwarted* by irritating purgatives. The surgeon's anxiety to procure stools should yield to the evident necessity for time being allowed for the restoration of the natural powers of the injured bowel."

Fig. 278.



Spica bandage.

Three, five, ten, or even twenty days may be allowed to pass without any action of the bowels, without anxiety or without purgatives, so long as no other indications of mischief show themselves, but during this time only liquid food is to be given with stimulants as may be required. When some local distress is present, which the surgeon can fairly attribute to the constipation, an enema of gruel and olive oil may be administered, which may be repeated if necessary, such a simple intestinal stimulant being usually sufficient to induce the bowel to act should it have recovered its tone. When the bowels have acted naturally, convalescence may be declared and the usual diet allowed.

Any violent action of the bowels soon after the operation must be watched with anxiety, and in the aged it is too often followed by a fatal collapse. When too profuse it must be checked by opium. The patient on no account should be allowed to get up and walk until he has been fitted with a good truss.

It occasionally happens that, after the reduction of a hernia by operation, the symptoms of strangulation persist, and the surgeon is in doubt as to their cause. Under these circumstances, the wound may at times require reopening, and the parts at the neck of the sac re-explored, since the case may be one of those of "displaced herniæ" to which attention is now to be drawn.

As a rule, however, the persistency of the symptoms is due to the obstruction caused by the injured bowel, or to the anæsthetic.

When the bowel, however, has not gone up at the time of the operation with the usual rush, or the surgeon has any doubt in his mind as to its right reduction, the wound should be reopened, the utmost caution being observed by the surgeon in examining the parts about the neck of the sac.

Multiple Herniæ.

When *two or more herniæ* exist with symptoms of strangulation, the one that on careful examination appears to be the most tender ought first to be explored, and should this operation not give relief, the second should be treated in a like manner; indeed, if no relief be given by the second operation and a third hernia exist, it should also be explored, for it cannot be too often repeated, that the operation is not one of danger when compared with the necessity of the case that demands it. Dupuytren in his 'Leçons Orales' has recorded such a case. In the third part of my 'Clinical Surgery,' p. 204, I have likewise recorded another in which Mr. Cock was the operator. The patient was a man æt. 70; the left side was first explored, but as the symptoms continued the right was operated upon twelve hours later. Both herniæ were old inguinal, in both the sac was opened, and recovery took place. In the case of a Jewess, æt. 30, I was called upon to see, with double femoral herniæ and umbilical, I operated on this occasion upon the right femoral for strangulation, and a year later upon the umbilical with success.

Displaced Herniæ.

No cases demand closer attention than these. When understood and appreciated they may be successfully treated, and when misunderstood they are sure to be overlooked. Hence it may be accepted as a fact, that a strangulated hernia with its sac may be bodily reduced within the abdominal ring and behind the abdominal parietes, the intestine being still held by the neck of the sac (Fig. 269). This form was first described by the French writers as "reduction en bloc," or "en masse," and by Mr. Luke in this country ('Med.-Chir. Trans.,' 1843). The majority of cases reputed to be of this nature are, however, probably caused by other lesions of the sac, and the credit of having made this out is due to Mr. Birkett, in an able paper read before the Med. Chir. Society in 1859. He describes three forms, though his observations apply only to inguinal hernia.

It would appear, therefore, that there are four varieties of displaced hernia.

In the *first* the strangulated hernia with its sac may be bodily reduced within the abdominal ring and behind the abdominal parietes, but it is only to a femoral hernia that this accident can occur. It is the true "reduction en bloc," or "en masse," of the French writers and of Luke. Such cases are, however, rare. In November, 1871, I had this fact demonstrated to me in a case I was called to see by Mr. Berry of Pentonville. It was in a lady, æt. 64, who was said to have been ruptured for years, and had worn a truss. When I saw her she had been vomiting for a week, and a tense femoral hernia existed. Under chloroform, I cut down upon the sac and divided the neck of the crural ring, and on attempting reduction of the sac's contents by gentle manipulation, to my surprise the sac with its contents suddenly disappeared into the abdomen. By a little abdominal pressure it was made to reappear, and it did so in the same sudden way. A second attempt at the taxis was followed by the same result, and renewed pressure upon the abdomen with a like reappearance. For the sake of fully satisfying myself and my medical friends of the nature of the case, I reduced the hernia *en masse* a third time, and then found some little difficulty in securing its reappearance. When I did so, I took hold of the sac with my forceps, carefully opened it, and exposed the bowel without letting the sac go; I then divided its neck by a herniotome and reduced the bowel, keeping the sac well down. On the second day the bowels acted, but the patient subsequently died of a low form of peritonitis. In this case the whole process of reduction *en masse* was demonstrated most clearly, and it compelled me to ask the question whether the same result might not have taken place had I attempted its reduction by forcible taxis without operation, since the facility with which the sac passed up within the crural ring was something startling.

In Prep. 2503^{80}, Guy's Hosp. Museum, this accident may be seen. It was taken from a woman æt. 58; and my friend Mr. Henry Morris showed a specimen illustrating this fact at the Pathological Society. *Vide* 'Trans.' for 1871.

In the *second* form the neck of the sac becomes detached by force from the internal abdominal ring, and pushed upwards beneath the abdominal walls, the intestine within the sac being strangulated by the orifice of the sac. This variety is illustrated by diagram 266, and still better in Figs. 279 and 279A, which I have copied from page 486 of the first vol. of the 'Medical Gazette,' published in 1828. The case formed the subject of a lecture by Sir Charles, then Mr. Bell. It occurred in a man, æt. 47, who had been the subject of a right scrotal hernia for twenty years, which had come down and become strangulated three days before, but had been reduced, or rather *made to disappear*. The symptoms, however, continued, and death followed. During the last twenty-four hours of the patient's life the hernia came down repeatedly during the day, and was each time reduced with great facility.

After death the hernia was found to be in the scrotum, strangulated and mortified (Fig. 279). On applying pressure to it "the intestine could very easily and effectually be pushed through the external abdominal ring, so as to be hid from sight. On looking to the inside, however, it was seen that the portion of gut had carried the neck of the sac before it into the abdominal cavity B, Fig. 279; and the duplicature of peritoneum which hung upon the inside of the neck of the sac being unfolded, had formed a new sac for the intestine in the inside of the abdominal muscles. Thus the fold of intestine was pushed through the external ring, through the spermatic canal, and through that part which is described to be an internal ring (but of which no trace could be seen), and was reduced within the abdominal muscles but not within the abdominal cavity," the neck of the sac still grasping the included portion of gut (B, Fig. 279A). The hernia was also clearly of the congenital form, although it had not descended as far as the testicle.

The two drawings (Figs. 279 and 279A) and descriptions are given as originally described by Sir C. Bell.

This case I have described somewhat fully, as I believe it to be the earliest on record in which this accident has been clearly made out. In it the neck of the sac had evidently been pushed upwards within the internal ring with the strangulated bowel.

In the *third* form (Fig. 267), "as the effect of forcible and long-sustained compres of the hernial tumor, the delicate serous membrane of the sac is rent, burst, or torn, the hernia makes its escape through the aperture into the sub-serous connective tis its course outside the peritoneal sac is advanced by continued pressure ; and detaching

FIG. 279.

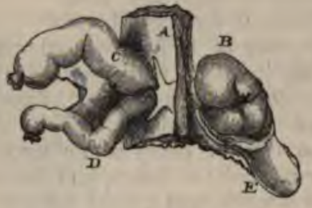
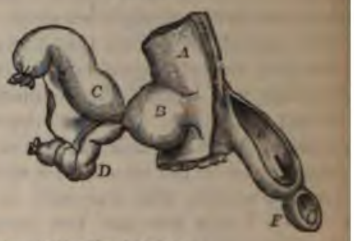


FIG. 279A.



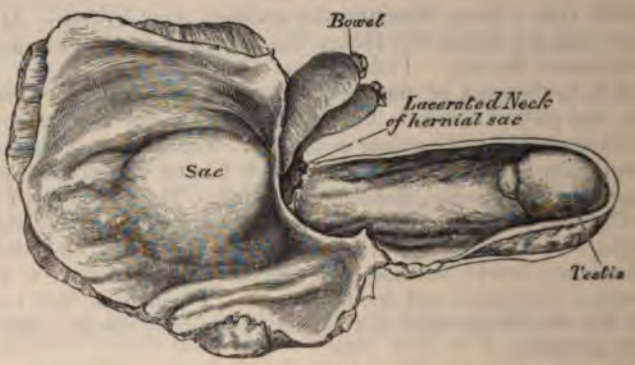
Drawing illustrating the second varieties of displaced hernia.

A. A portion of the abdominal muscles, with the peritoneal lining.
B. The strangulated fold of intestine.
E. The testicle.
The dark lines at the neck of the sac represent the duplicature of the peritoneum, which being unfolded formed a sac for containing the intestine when reduced.

A. Peritoneum lining the abdominal parietes.
B. The tumor formed when the strangulated in was pushed through the spermatic canal into t formed by peritoneum in the inside.
C. The superior portion of intestine.
D. The inferior.
E. The scrotal hernial sac.
F. The testicle, with the vaginal coat opened.

connections of the neighboring peritoneum, it forms for itself a pouch between that se membrane and the internal abdominal fascia."—BIRKETT. The posterior part of neck of an inguinal hernial sac is the usual seat of the rupture, and the position of artificial sac is downwards and outwards. The "congenital" form of hernial sac is the more liable to the accident (*vide* Fig. 280).

FIG. 280.



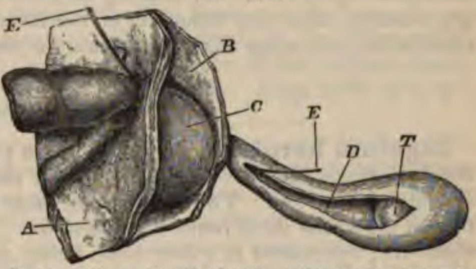
Third variety.
Interstitial hernia with ruptured neck of hernial sac.

The indications of the accident having taken place are as follows: I give th Birkett's words—"The tumor becomes flaccid, and, therefore, smaller; the bulk tumor slowly diminishes as the pressure is continued, until at last very little, if any can be felt, but the *surgeon has failed to experience that sudden jerk so characteri the escape of the hernia* from the gripe of the mouth of the sac, as it enters the abdo cavity. After the effects of the chloroform have passed away, *all the symptoms strangulated bowel recur*, and, perhaps, with increased force. Even the tumor itsel reappear and recede on the application of slight pressure."

When this condition is found, there is but one form of practice to follow, and th the exploration of the sac. At its neck two orifices will be found, one dipping dow the artificial sac, and the second into the abdominal cavity; from the latter, the will be seen to pass through the former into the artificial sac. The surgeon must draw out the bowel from the sac through its false orifice, and having freely divide true neck or abdominal orifice of the sac, replace the intestine, and "the exercise of care and caution is needed to prevent the entrance of the hernia once more into the abnormal space outside the peritoneal cavity."—BIRKETT.

In the *fourth* form, an intermuscular, interstitial, or *intra-parietal* sac has also been described, being a kind of diverticulum from the inguinal sac, and is almost always found, according to Birkett, associated with the congenital form of hernia. This sac may be found in the anterior abdominal walls, in an upward, outward, or inward direction, mostly behind the abdominal muscles in front of the abdominal fascia, though in some instances in front of the external oblique muscle beneath the skin. Birkett refers to a case recorded by Scarpa, and to a second by Dr. Fano. In some cases, the sac extends to the iliac fossa and rests upon the iliacus muscle, between the internal abdominal fascia and peritoneum; or directing itself inwards, it passes behind the horizontal ramus of the pubes and reaches the side and front of the urinary bladder (Birkett). Diagram 268 illustrates this form of hernia, but Fig. 281 does so much more clearly. It was taken from a preparation now in Guy's Museum, which was removed from a man, æt. 36, upon whom I operated on September 23d, 1869, for strangulated hernia. The man had been ruptured for fifteen years, and had worn a truss. The hernia had descended two days before his admission into Guy's, but the man had pushed it up by manipulation after a little trouble, though it did not go up as usual with a rush. After its reduction, vomiting appeared and local pain, and in this condition he was admitted into the hospital.

FIG. 281.



Drawing illustrating the fourth variety or intra-parietal form of displaced hernia.

A. Peritoneum lining the abdominal muscles (B).
C. Intra-parietal sac with strangulated bowel.
D. Scrotal hernial sac leading down to testicle (T).
E. Director passed from the congenital scrotal sac through the internal ring.

In the drawing the strangulated bowel has been introduced to make the description clearer.

When I saw him all the symptoms of strangulation were present. No hernia was down, but there was some fulness at the internal ring, and above this towards the crest of the ilium, a tense globular swelling could be felt. This swelling I explored, and having laid open the inguinal canal I exposed the empty hernial sac (D, Fig. 281), with the testicle, showing that the hernia was of the congenital form. I then passed my finger into the internal ring and came against a knuckle of tense distended intestine. I enlarged the opening and this intestine at once protruded which was of a dark color but still glistening. In following up this intention my finger passed downwards and outwards into a distinct cavity (C, Fig. 281), filled with bowel, but which was not the abdominal cavity. It was a distinct sac, with a smooth surface, and about the size of an egg. At its upper surface, it communicated with the hernial sac, and above this, with the abdominal cavity. I then increased the orifice leading into the abdominal cavity, drew out the strangulated bowel from the intra-parietal sac (C, Fig. 281) and returned it into the abdomen. The sac was clearly placed below the internal ring and between the abdominal muscles and peritoneum. The man died from peritonitis on the fourth day, his death allowing me to take the very excellent preparation from which Fig. 281 has been taken. The case was clearly one belonging to Mr. Birkett's third form or my fourth, an intra-parietal sac (Fig. 281, C) existing below the internal ring.

The disappearance of the tumor without the characteristic jerk and the persistence of the symptoms indicate all these forms. The treatment in all is the same as that described in the *third* form.

Prognosis.—As the danger of a strangulated hernia depends upon the amount of damage the intestine has sustained by the strangulation, so the amount of damage the bowel has received is to be measured by the intensity of the strangulation and the length of its duration. A tight unyielding strangulation, such as usually exists in a femoral or in a direct inguinal hernia, does more harm in a short period than a less tight and more yielding constricting force, such as is met with in oblique inguinal hernia, in a longer period; violent taxis adding materially to the danger of the case.

The existence of peritonitis before the reduction of the hernia is always an unfavorable sign, as it is not likely to be lessened by the introduction into the peritoneal cavity of a portion of bowel already inflamed and altered in character. A hernia in an otherwise healthy subject, that has not been strangulated for many hours, that has not been injured by violent manipulation, and has been reduced by the "minor" operation, will probab do well, when another that has been strangulated for days, or been subjected to viol taxis, will probably do badly.

Where disease of the kidneys or of other viscera exists the prognosis is always unf orable, and, in old people, the same opinion must be formed.

A case in which the intestine has been freely exposed is more unfavorable than one which no exposure has taken place, and any excessive manipulation of the hernial c tents always adds to the danger.

The reduction of a severely damaged intestine is more liable to be followed by a b result than where little injury exists, but a slightly injured bowel in an aged or unheal subject is always likely to do badly.

A recent hernia requiring operation is always far more fatal than an "old case."

In private practice, where herniæ, as a rule, are discovered and treated early, good s cess follows herniotomy, but in hospital practice, where neglect and delay combined h had their influence, treatment is very unsuccessful, nearly one half the cases dying. Guy's Hospital the average period of strangulation for femoral hernia is seventy-six hou of inguinal, fifty; and half the cases that die after the operation do so within forty-ei hours, the injury to the bowel being so great and the power of the patient so reduced, t any reaction after the reduction of the hernia is rendered impossible. Under these cumstances, the worst that can be said for the operation is, that it fails to cure.

Inguinal Hernia.

Inguinal hernia, or that form which protrudes through the internal or external dominal rings, includes two-thirds of all cases of hernia, and about half of all cas strangulated hernia. Two out of three cases of strangulated inguinal hernia are redu by the taxis, the third requiring operation. In hospital practice, half of those ope upon die; operations in recent cases being most fatal.

An inguinal hernia is called *oblique* when it passes through the internal ring and the inguinal canal downwards towards the scrotum; *direct*, when it does not pass th the internal ring, but through the external in a direct way.

The oblique, from being anatomically placed external to the deep epigastric arte called *external oblique*, while the direct from being internal to the same vessel is k as the *internal direct*.

When the oblique has not passed the external ring, it is known as a *bubonocele*; the oblique or direct has passed into the scrotum it is called a "*scrotal hernia*" or "*o cele*."

In the *oblique inguinal*, the sac of the hernia may be the natural "vaginal proc peritoneum" that was formed on the descent of the testicle in fœtal life, and has not c *i. e.*, "*a congenital sac*" (Figs. 261, 262, 263); or an *acquired sac* formed by the g pouching of the parietal peritoneum through the ring (Fig. 265).

In the *direct inguinal*, the sac is always of the acquired form.

This "vaginal tubular process of peritoneum" which communicates above at the nal abdominal ring with the peritoneal cavity, and below is in close contact with a herent to the testicle, lies in front of the spermatic cord, and before birth, or soon "it contracts near the head of the epididymis, its surfaces adhere firmly at that spo thus two cavities are formed." The inferior one forms the permanent covering testis, and is known as the tunica vaginalis propria testis. The superior canal, wh arrest of development takes place, subsequently contracts—commencing at the i ring, and creeping up till the canal ceases to exist.

When an arrest of development occurs and the abdominal orifice of the tubular p remains patent, a piece of intestine may at any time descend. *When the whole le* the canal is open, the hernia will pass down *at once* into scrotum to the testicle m its presence, and in this way the "*congenital hernia*" of Haller, the "*hernia of in* of Malgaigne, or the "*hernia into the vaginal process of peritoneum*" of Birkett, is t (Fig. 261).

When the closure of the canal takes place higher up (and such an event is possi any point from the testicle upwards) the descent of the hernia will be limited, tho nature is the same, the only difference being, that in this condition the testicle will be below the hernial sac at a variable distance and separated from it. To this form o rure, Birkett has given the name of "*hernia into the funicular portion of the v process of the peritoneum*" (Fig. 262).

It should also be mentioned, that it is not uncommon for this tubular vaginal process to close at its abdominal orifice at the internal ring, and yet remain more or less open as a cavity below; and, under these circumstances, any *sudden rupture or giving way* of the closing medium will be followed by the rapid formation of a hernia, the hernia being scrotal wholly or in part, lying upon or separated from the testicle, according to the absence or position of any point of closure. This form of hernia differs only in the sudden giving way of the abdominal orifice of the vaginal process from those last described, and is very common in young adults.

To all those forms of hernia in which the sac is composed of the natural tubular vaginal process of peritoneum, the term "*congenital form*" of hernia would probably be the best, as indicating their nature, distinguishing them from the other form rightly called the "*acquired*."

This congenital form of hernia is also frequently associated with some malposition of the testicle, such as its non-descent or partial descent.

The "*infantile hernia*" of Hey, or the "*encysted hernia of the tunica vaginalis*" of Sir A. Cooper, is an acquired hernia, the hernia *gradually pushing* the tissues closing the orifice of the vaginal process of peritoneum downwards into the open canal, the protruded parts together with the sac being contained in the tunica vaginalis testis, and the true sac being within that which might have been the congenital (Fig. 264).

The hour-glass contraction of a scrotal hernia is always found in the "congenital form," and is due, as described by Birkett, to the imperfect closure of the vaginal sheath above the testicles, where union of its walls normally takes place. Prep. 2368 in Guy's Museum will explain these cases, also Fig. 263.

The acquired form of inguinal hernia, oblique or direct, is *always slow* in its formation, the pushing downward of the parietal layer of peritoneum by the protruding viscera being a gradual process, thus forming a marked contrast with the congenital form. In the oblique, it begins as a slight yielding at the internal ring, and, in the direct, at the external, this yielding passing into a "pouching," till at last the pouch may reach and even fill the scrotum. In the early stage, this yielding may be scarcely perceptible, but to the patient it will give rise to a feeling of weakness and often of pain on any abdominal muscular exertion being made. When a "pouching," or, according to Malgaigne, a "pointing" of the hernia has commenced, any act of coughing or straining will make it visible.

When the *oblique* hernia has filled the inguinal canal, it will appear as an ovoid swelling *above* Poupart's ligament (*vide* Fig. 270), beneath the tendon of the external oblique muscle. When it has passed through the external ring, the long axis of the tumor, and more particularly its neck, will still be in the inguinal canal above and parallel with Poupart's ligament; but, having escaped from beneath the external oblique muscle, it will appear as a pyriform scrotal tumor of variable size. The testicle will always be found below and distinct from the sac, the cord being behind the tumor.

In the *direct* inguinal form in which the pouching of the hernial sac is directly behind the external ring (Fig. 271), there will be no inguinal neck such as exists in the oblique, the hernia passing directly through the external ring down into the scrotum. This form of hernia has thus a more globular shape than the oblique.

When the *oblique* inguinal is reduced, the surgeon can pass his finger through the external ring along the inguinal canal upwards and outwards into the internal ring, and thus into the abdominal cavity, although in old herniæ, the two rings are brought closer in apposition than in the more recent. In *direct* inguinal, the finger having passed the external ring, seems to enter at once into the abdominal cavity, the opening being directly behind the external ring, and, with the finger passed through the neck, the external border of the rectis muscle may be felt on the pubic bones. By these points the *diagnosis* between the acquired oblique and the direct inguinal can be made out.

With respect to the points of difference between the "congenital" and "acquired" form of oblique inguinal hernia, a few words are needed, and may be thus epitomized. The congenital form is *the* hernia of infancy and young adult life, the "acquired" that of middle life and old age. A hernia that has formed *suddenly, and passed at once* into the scrotum, is probably of the "congenital;" whereas one that has been produced slowly is more likely to be of the "acquired" form. When the hernial tumor envelops the testicle and renders its detection impossible or difficult, the "congenital form" is indicated. When the testicle is in its right place and distinct from the hernial sac, the "acquired."

A hernia with a long tubular neck occupying the inguinal canal is probably of the "congenital" kind, a short thick neck being more common in the "acquired."

The youth of the patient, the rapidity of its formation, and its close connection with th testicle, are the three chief points characteristic of the "congenital" form of hernia. The age of the patient, the slowness of its production, and its distinct separation from the testicle, the three points indicative of the "acquired."

The diagnosis of an inguinal hernia from other tumors is only difficult in exceptional cases. No scrotal tumor beginning in the scrotum and developing upwards can be a hernia, for all herniæ descend towards the scrotum. So, when a distinct separation exists between the scrotal tumor and the external ring no difficulty in diagnosis ought to be experienced. In this way ordinary hydroceles, hæmatoceles, and all diseases of the testicle are excluded.

When a *hydrocele*, however, passes through the external up to the internal ring, a condition by no means uncommon in infancy and young adult life when the vaginal process of peritoneum is only closed at its abdominal orifice, some difficulty may be experienced; but in the absence of all symptoms of hernia, the translucency of the tumor, and the history of the case, viz., that the swelling began below and travelled upwards, are sufficient to point out the nature of the affection.

Congenital hydroceles into the vaginal process are to be distinguished from congenital hernia by their transparency, by the gradual filling of the sac, and by their vibration on percussion, whereas a hernia is opaque, enters the sac rapidly, leaves it quickly, and does not vibrate.

An *encysted hydrocele* of the cord appears as a tense, fluctuating, transparent, irreducible tumor, and ought not to be confused with a bubonocele when no other symptoms of hernia exist beyond the swelling.

The wormy feel of a *varicocele* or varicose spermatic veins, and the fact that pressure sufficient to keep any hernia in position with the patient erect over the external ring renders the varicose veins more marked, should prevent it being mistaken for a hernia. And if the surgeon would only look for the two testicles in every case of scrotal or even inguinal swelling, he could not fall into the error of mistaking an undescended testicle, or one resting at the internal ring or in the inguinal canal, for a hernia or any other disease.

When a hernia and hydrocele coexist, some difficulty may be experienced in the diagnosis; but, as each affection has its own symptoms, the diagnosis ought not to be very difficult.

Whenever a doubt in diagnosis is felt about an inguinal tumor and symptoms of a strangulated hernia are present, the golden rule in surgery should be observed, and the doubtful tumor explored.

I had an interesting case (Feb. 1872) with the Messrs. Toulmin, of Clapton, illustrating this, in a boy, æt. 4, who had an acute hydrocele associated with a sudden descent of a hernia into the vaginal process of the peritoneum of the cord. I tapped the hydrocele and left the inguinal tumor, thinking it might be possibly a hydrocele of the cord, as no symptoms of strangulated bowel were present. These, however, soon appeared, and chloroform was given with a view of exploring the tumor, when, by the taxis, the hernia was happily reduced and the boy recovered.

Inguinal hernia is very common in the female child, indeed, under puberty, it is the usual kind, and is always of the "congenital form," the bowel coming down into the open canal of Nuck. It is found, however, at all periods of life, though as a direct hernia it is only seen in the adult. The rupture may consist of the ovary and descend into the labium. It can be recognized by the same symptoms as in the male, and should be treated on the same principles. A hydrocele of the cord may be mistaken for a hernia.

TREATMENT.—A reducible inguinal hernia is to be kept up with a truss, whether in the infant, child, or adult; the truss too must be *well fitting*, exerting sufficient pressure to keep the hernia in position *but no more*. Should the hernia come down when the truss is on, it ought to be reduced, and the truss reapplied. The pressure of the pad in the oblique form should be over the *internal;* but in the direct, over the *external ring*. In infants, a complete cure is often obtainable by these means in a year or so, and if no descent or any other symptom of hernia shows itself for another year, the truss may be left off. In cases of hernia occurring after infancy, it is, however, never safe to leave off a truss. When some malposition of the testis complicates a case of the congenital form of hernia, care must be taken that the pad of the truss does not press the testicle, and, when the testicle and hernia are both in the inguinal canal, no truss can be tolerated.

Irreducible, inflamed, obstructed and strangulated inguinal herniæ are to be treated on the principles already stated.

When a hernia cannot be kept up with a truss, but under no other circumstances, the question of the operation for the *radical cure* of the hernia may be entertained, as the operation has its dangers, and Wutzer, its early advocate, admits that a truss is necessary for life subsequently.

A strangulated *direct* inguinal hernia is, however, a far more serious affection than the *oblique*, the sharp unyielding edge of the ruptured tendon surrounding the neck of the sac acting as rapidly upon the strangulated bowel as does the edge of Gimbernat's ligament in femoral hernia.

The Radical Cure of a Hernia.

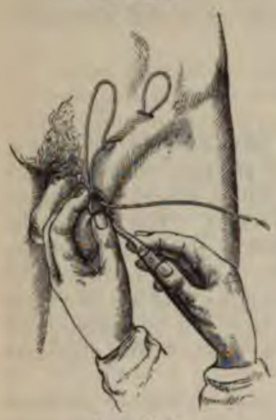
This has been the aim of surgeons from time immemorial; and, were hernia only a mechanical lesion due to a weakness of the walls through which it protrudes or of the neck of the sac, some success would probably have attended the practice; but as a rupture is more probably due to something more than this, it can hardly be expected that any very good result should have been obtained. Gerdy, Wutzer, Rothmund, Wells, and Davies, have all tried to accomplish this by plugging the mouth of the sac with its invaginated fundus, Gerdy fixing the invaginated fundus by means of two sutures; Wutzer by means of a cylindrical wooden plug passed into the inguinal canal in the hollow of the invaginated structures up to its neck, and a grooved wooden pad being applied externally over the first to hold the parts in position. The two wooden instruments being held together by a needle (which is inclosed in the cylindrical part and made to pass through the internal ring and external tissues) and a screw; the plug should be retained for six or seven days. Rothmund, Wells, Davies, and others, have only improved upon Wutzer's method. Mr. Birkett, however, tells us on the authority of Dr. Otto Weber, of Bonn, the late clinical assistant to Wutzer, that Wutzer is still of opinion that his operation is not dangerous when properly performed, and that by his method, the fundus of the invaginated sac may be made to adhere to its neck, and as a consequence of this, *if the patient continue to wear a truss for life, a return of the hernia may be avoided.* Dr. O. Weber, however, writes that he has never seen any of the so-called "cured cases" radically cured; that the plug of skin is by degrees entirely drawn out again; that the external and internal rings are not closed by the operation; that an imperfect cure may be effected by means of a partial closure by adhesion of the internal walls of the neck of the sac and thickening of the surrounding tissues. In London practice, it is also well known, that a fatal peritonitis has followed the attempt. With these facts before us respecting the so-called cure by invagination, and the knowledge that even when the cure has been effected the wearing of a truss is still an essential point of practice, the operation may be dismissed as one that cannot be recommended.

Mr. Wood, of King's College, believing that Wutzer's principle of practice was as wrong as his practice was unsuccessful, devised in 1863 an operation, by which the hernial sac, without the skin, is invaginated into the canal, and the hinder and inner walls of the inguinal canal are drawn forward by means of sutures, and fixed to the anterior and outer walls.

The steps of the operation are conducted as follows. They are taken from Druitt's 'Vade Mecum,' as revised by Wood:—

The patient being laid on his back, with the shoulders well raised, and the knees bent, the pubes cleanly shaved, the rupture completely reduced, and chloroform administered, an oblique incision, about an inch long, is made in the skin of the scrotum over the fundus of the hernial sac. A small tenotomy knife is then carried flatwise under the margins of the incision, so as to separate the skin from the deeper coverings of the sac, to the extent of about an inch, or rather more, all round. The forefinger is then passed into the wound, and the detached fascia and fundus of the sac invaginated into the canal. The finger then feels for the lower border of the internal oblique muscle, lifting it forwards to the surface. By this means the outer edge of the conjoined tendon is felt to the inner side of the finger. A stout semicircular needle, mounted in a strong handle with a point flattened antero-posteriorly, and with an eye in its point, is then carried carefully up to the point of the finger along its inner side, and made to transfix the conjoined tendon, and also the inner pillar of the external ring. When the point is seen to raise the skin, the latter is drawn over towards the median line, and the needle made to pierce it as far outward as possible. A piece of stout copper wire, silvered, about two feet long, is then hooked into the eye of the needle, drawn back with it into the scrotum, and then detached. The finger is next placed behind the outer pillar of the ring, and made to raise that and Poupart's ligament as much as possible from the deeper structures. The needle is then passed along the outer side of the finger and pushed through Poupart's ligament, a little below the deep hernial opening (internal ring). The point is then directed through the same skin puncture before made, the other end of the wire hooked on to it, drawn back into the scrotal puncture, as before, and then detached. Next, the sac at the scrotal incision is pinched up between the finger and thumb, and the cord slipped back from it, as in taking up varicose veins. The needle is then passed across behind the sac entering and emerging at the opposite ends of the scrotal incision. (Fig. 282.) The end of the inner wire is again hooked on, and drawn back across the sac. Both ends of the wire are then drawn down until the loop is near the surface of the groin above, and are twisted together down into the incision, and cut off to a convenient length. Traction is then made upon the loop. This invaginates the sac and scrotal fascia well up into the hernial canal. The loop of wire is finally twisted down close into the upper puncture, and bent down to be joined to the two ends in a bow or arch, under which is placed a stout pad of lint. The whole is held steady by a spica bandage. (Fig. 278.) The wire is kept in from ten to fourteen days, or even longer, if the amount of consolidation is not satisfactory. Very little suppuration usually follows, but after a few days the parts can be felt thickened by adhesive deposit. The wire becomes loosened by ulceration in its track, until it can be untwisted and withdrawn *upwards*. In this operation the hernial canal is closed along its whole length, and an extended adherent surface is obtained to resist future protrusion.

Fig. 282.



From Wood.

After the operation, Wood says, a horse-shoe pad should be worn for a few months, *and the truss is not to be thrown aside when the patient is about to be subjected to violent strains or lifting*. This is important to remember; though it tends much to do away with the value of the operation.

Modifications of the operation are employed for infants, &c.

The ingenuity of this operation is great, and *where the radical cure is called for* should be employed. Wood says ('Lancet,' August, 1873) he has operated 200 times with three deaths, and out of 107 cases in which the results were more or less perfectly known, in 51 a return of the hernia took place, of which 42 returned within the year; in 56 a satisfactory result was secured. Thus, in the most favorable light, there is one failure to one success, and risk to life. It is to be feared, however, that a large number of these so-called satisfactory cures are only so when they leave the operator's hands, since Kingdon's Reports of the City of London Truss Society tell us, that within the last ten years, fifty persons who had undergone some operation for the radical cure had, in consequence of its failure, applied for trusses; and this number is large, considering the surgeons who perform this operation are not numerous, nor the cases abundant.

For my own part, I believe, that where a hernia can be kept up by a truss, and the patient is likely to remain in a civilized country where trusses can be obtained, any operation for the radical cure is unjustifiable. To risk the life of a patient on the theory of a cure, when a truss, as a matter of safety, has to be worn subsequent to the operation, is both unfair and unsatisfactory.

When a hernia is reducible and cannot be kept in place by a truss; when a patient is going abroad where trusses are not to be obtained, or only obtained at too great a cost, the operation for the radical cure may be undertaken. Indeed, under these circumstances I have performed Wood's as well as Wutzer's operation with good success; that is, the patients who previously could not keep up their hernia on account of the great size of the inguinal ring were enabled to do so. Under all other circumstances, I have refused to undertake it.

In the "congenital form" of inguinal hernia, there seems a better prospect of success following the operation than in any other, and a better basis for the practice; for "thus allowing nature to guide our procedure, we must make it a rule to select those cases in which her efforts have failed; and by acting as her handmaid, we may reasonably hope to arrive at a successful result." (Birkett.)

FEMORAL HERNIA.

This forms about one-tenth of the whole number of cases of hernia, and about forty per cent. of all cases of strangulated hernia; and is also far more liable to become strangulated than inguinal, though less likely to be reduced by the taxis. The taxis, moreover, is more prone to produce injury. One out of three cases of strangulated femoral hernia is reducible by the taxis, two being operated upon, and of these 40 out of every 100 die, the operation after "recent hernia" being twice as fatal as it is after the "old"—a strangulated femoral hernia going on more rapidly to destruction than any other, and a strangulated "recent" than an "old" hernia.

Femoral hernia descends from the abdominal cavity through the crural ring *inside* the femoral vessels. The free margin of Gimbernat's ligament bounds its inner side, and the sac which is always acquired, pouches downward beneath Poupart's ligament and emerges through the saphenous opening to the inner side of the falciform process of the fascia lata. The hernia expands laterally, resting upon this fascia, and, as it enlarges, turns upwards over Poupart's ligament, then in the direction of the crest of the ilium, very rarely spreading downwards. Its long diameter will be transverse and not vertical. The neck of the hernia will always lie *outside* the spine of the pubes or the tendon of the long adductor, while an inguino-scrotal or labial hernia will always be found *inside* these points. The deep epigastric artery and vein usually lie outside the neck of the sac, and are free from harm in the operation; though when the obturator comes off from the epigastric, and arches over the neck of the hernia to dip down on its inner side towards the obturator foramen, it may be divided when a *free* incision is made.

Rare cases of femoral hernia occur external to the femoral vessels as related by Partridge ('Path. Soc.,' vol. i), as well as through Gimbernat's ligament, or with a diverticulum through the cribriform or superficial fascia. (*Vide* Birkett.)

Diagnosis.—The points already stated will enable the student to distinguish a femoral from an inguinal hernia.

A psoas abscess dilates on coughing, and disappears or diminishes on the patient lying down, just as does a hernia; but it is usually placed beneath and outside instead of inside the vessels. It is often accompanied also by spinal symptoms; and, on manipulation, gives the sign of fluctuation from above to below Poupart's ligament.

A varix of the femoral vein may also in a measure simulate a hernia; but, whereas in a hernia, with the patient erect, pressure over the crural ring and vessels will prevent its descent, in varix it will cause its enlargement.

An enlarged gland ought not to be mistaken for a rupture, as the history of the case and concomitant symptoms generally mark its nature.

Cysts in the crural ring are doubtless difficult to diagnose, although from their always being in the same spot under all circumstances, and from their not being influenced by position, coughing, &c., they are unlike hernia. When associated with a strangulated hernia they may complicate, but seldom lead to error.

TREATMENT.—Reducible hernia can be treated by a truss, the pad pressing in the hollow below and external to the spinous process of the pubes. The radical cure has been performed by Wood, Wells, and Davies, but it cannot be recommended.

Strangulated femoral hernia requires the most prompt attention, for the parts constricting the neck of the sac are so unyielding as to produce in a short period an amount of damage which is too often irreparable. In the application of the taxis, the utmost gentleness should be employed, and the administration of chloroform should always precede the attempt. In the reduction of an old femoral hernia, the taxis rarely succeeds.

In reducing a femoral hernia by the taxis, the surgeon should always remember the position of the orifice of the sac, for when it has turned over Poupart's ligament, any pressure on the tumor can only do harm. The tumor should be gently raised by the fingers, and drawn slightly downwards and to one side before pressure is applied, which must be of the mildest kind. If the slightest disposition to yield be shown, the pressure may be continued, because when any of the contents of the sac are emptied, the probabilities of the reduction of the whole are greatly enhanced. If no yielding be felt in the parts, the taxis had better be given up, and the operation performed.

In all operations for femoral hernia, the reduction of the hernia without opening the sac should be preferred, and, in "recent" hernia this "minor" operation is generally successful. The incision to expose the sac consequently should be a limited one. Luke suggested that "a fold of integuments is to be pinched up and divided by transfixing it with a narrow blade, so that the incision when the skin is replaced shall fall perpendicularly to the body with its centre opposite to the depression, which indicates the seat of strangulation." But this plan is, in a measure, dangerous, as I have seen Mr. Aston Key with the point of his knife divide all the tissues outside the sac and even the sac itself in perforating the skin-fold, and have known a less skilful surgeon open the bowel.

Mr. Gay advises "an incision rather more than an inch long to be made near the inner side of the neck of the tumor. The superficial fascia to be divided, and a director or *bistouri caché* introduced down to the neck of the tumor, and through the crural ring, by the least amount of force, and with the aid of a little gentle compression of the inner side of the tumor by the finger, the point of the bistoury may be insinuated between the sac, or, rather, fascia propria, and the pubic margin of the ring; the edge of the knife is then to be turned towards the pubes, and by projecting the blade the seat of stricture in that direction may be effectively divided." When a director is used or the finger, the ordinary hernia knife may be applied in the same way.

Nothing can be more satisfactory than this operation when reduction is effected by it, and it should always be attempted. If it fail, and the sac has to be opened, no harm can possibly have been caused by the proceeding, as the incision can readily be enlarged, if necessary, the sac opened, and its neck divided. Any modification of the incision, however, may be made. The essential point is, that the incision should be of such a nature as to allow the surgeon to reach with facility the neck of the tumor. In operating, the surgeon must also remember the fascia propria or fascia that is external and superficial to the sac, which will always appear as a well-defined sac on the division of the soft parts that cover it, and that may be mistaken for the true sac. On its division, a layer of fat will often be found more or less lobulated, which is the subperitoneal fat, and beneath it will be found the true peritoneal sac. In Gay's operation, as already described, when the parts outside the fascia propria have been divided, and the hernia cannot be reduced, there is no objection to the surgeon dividing the neck of the sac upon a director, and when this fails, the sac must be fully opened. The flow of a stream of serum will probably attend this step, and, as previously stated, the nature of the fluid will indicate the condition of the parts within. When intestine is alone seen, the director may be carefully introduced into the neck of the sac and the constricting orifice divided, the intestine being then reduced with the gentlest pressure. When omentum covers the bowel, it should be carefully raised and unravelled, and when an omental sac exists, it must be torn through or carefully divided and dealt with as previously explained. The neck of the sac should be divided outside the omentum. The less the parts at the neck of the sac are disturbed the better; no introduction of the finger beyond the neck of the sac being necessary, and no passing of the director or hernia knife called for beyond the neck. When the neck of the sac has been divided, and the sac has subsequently to be opened to insure the reduction of its contents, it is seldom necessary to reintroduce the bistoury, the parts yielding enough to the finger to allow of the replacement of the hernial contents, for the less the neck of the sac is divided the better. The surgeon should always be careful that the hernia is not reduced within the crural ring, together with the sac; if so, the sac must be brought down again, opened, and held *in sitû* whilst its contents are returned. The after-treatment of the case is to be based upon the principles which have been already laid down.

OBTURATOR HERNIA,

or hernia through the foramen of that name, deserves a notice, as its successful treatment can only follow its diagnosis. It is more common in females than in males, and is often unattended by any external evidences of its existence. Birkett has collected twenty-five examples of this affection; though in fourteen the hernia was not discovered till after death. In three only was a successful operation performed: by Obré in 1851, Bransby Cooper in 1853, and Lorinson in 1857. Mr. Cooper's case I had the good fortune to see.

The sac of the hernia is always "acquired." It emerges in the thigh beneath the pectineus and between the adductor longus and femoral vessels. The hernia is consequently on a lower level than the femoral, and comes forward instead of downward. An obturator hernia is not, however, always to be felt, and a diagnosis has consequently to be made out of the general symptoms; and of these, *pain in the course and distribution of the obturator nerve is the most marked.* It is not, however, always present. In several of the recorded cases, during the development of the hernia, the pain described as "spasmodic contraction of the abdominal muscles" existed, and this fact is explained by Birkett in recalling the association there is between this nerve and the muscular filaments distributed on the abdominal muscles, all being branches of the lumbar plexus. Birkett also observed that movement of the hip-joint in the affected side excites or aggravates the pain, so does deep local pressure, and pelvic examination, either per vaginam or rectum. In the following case, however, which came under my care in 1875, none of these symptoms were present, though a fixed pain in the left iliac fossa existed. Susan G—, æt. 65, a married woman, was admitted under my care into Guy's Hospital on the 26th May, 1875. She had enjoyed excellent health till 1871, when one morning, after considerable exertion, she experienced great pain in the left side, and was able to sit down only with difficulty. The medical man who saw her said that she had a hernia, but that it had gone up. Her health after this remained indifferent, though she was able to go about till six months before her admission, when she passed no motion for nine days and was very sick. Purgative draughts, however, acted upon the bowels very freely, and she convalesced. She then continued well until ten days before her admission. At that time no motion had passed for ten days, she had continually vomited, looked very unhealthy, much emaciated and yellowish, was cold and collapsed, the abdomen being somewhat distended, with visible coils of small intestine and peristalsis. She also complained of diffused abdominal pain. No growth could be detected in the rectum. Opium was administered, and warm fomentations applied to the abdomen with relief, and, after four days, the bowels acted twice spontaneously, and subsequently she had repeated loose evacuations. She left the hospital convalescent though much emaciated, on June 15th, 1875, nineteen days after her admission. She was, however, re-admitted on December 26th of the same year, having remained quite well till December 3d, though for the last three months she had been in much reduced circumstances. On December 3d she was again violently sick, and had much pain in the *left side* of the abdomen, which was increased on passing a motion. The bowels were confined and the feces small. She had now a double femoral reducible rupture. Her abdomen was natural, and a rectal examination showed nothing abnormal. She was placed under the influence of opium, when the sickness ceased and the bowels acted. On January 6th, however, the symptoms returned. She was again sick, and had much pain in the left side of the abdomen, while the temperature rose to 101° F. From that time she gradually sank. The bowels were not again relieved, the abdomen became tympanitic, and the vomiting only ceased a few days before death, which took place on February 4th, with increasing exhaustion. She had at no time anything like obturator pain, and though all the regions of hernia were carefully examined, nothing was noticed to suggest the disease.

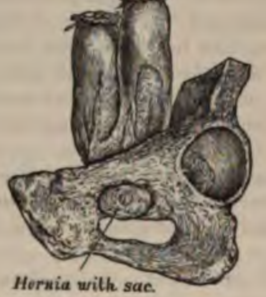
Autopsy by Dr. Goodhart.—The body was very emaciated; there was no marked distension of the abdomen; the peritoneum was injected all over. A little pus was smeared over the coils in the neighborhood of the cæcum, and in the pelvis, two ounces of pus or more had gravitated to the bottom of Douglas's pouch. No evident source of the pus could be discovered, though it is probable that it arose from peritonitis, due to overdistension of the bowel. The small intestine was only moderately distended, but crammed with pultaceous, yellow, fecal contents, and the coats were somewhat thickened. Following it downwards, the distension continued till two feet from the cæcum, where a piece of the bowel passed through the left obturator foramen. (Fig. 284.) Below this, the intestine was very contracted. The aperture in the obturator foramen was not large, and the intestine did not appear to be nipped in any way. A knuckle of bowel was in the sac, but the passage onward would not allow of the introduction of the little finger. The bowel was intimately adherent to the sac throughout, so that on opening the latter the bowel was wounded. The included bowel was grayish, but neither gangrenous nor inflamed. The mesentery was somewhat thickened at its neck, and within the bowel were some old ulcerations, as judged from the amount of thickening of the edges of an ulcer found at the neck of the hernia. The ulceration, however, was not within the neck, but rather on the opposite unincluded surface of the intestine. The sac pushed the obturator nerve and vessels well to the outer side and to its upper part, with the exception of one branch of artery, which passed to the thigh on the inner side.

The obturator muscle, which was in front of the sac, had to be scraped away to get at it. The sac was of nodular shape, and about two-thirds of an inch in diameter. (Fig. 283.) It caused no fulness externally on the thigh. This was looked for particularly, because the protrusion was first discovered from the inside. In addition to the hernia, another coil of bowel (small intestine considerably higher up) was adherent by a strong band at the hernial neck, and about this the distended coils had twisted in a peculiar and indescribable manner, yet no obstruction had resulted therefrom, the distension continuing both above and below it. A slight femoral protrusion also existed on both sides. On the right side, a little omentum was adherent at the neck of the sac, and, by its adhesion, dragged down the pyloric orifice of the stomach and the textures in the portal fissure.

Death, in this case, was clearly due to chronic intestinal obstruction, caused by the adhesions of the bowels to the hernial sac. The only special symptom worthy of note was, the fixed pain in the left side of the abdomen above Poupart's ligament.

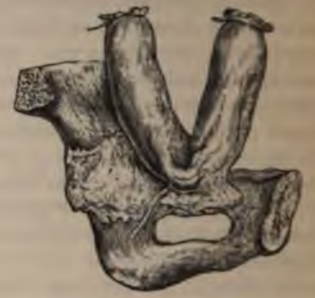
TREATMENT.—The taxis can hardly be expected to be a successful proceeding in obturator hernia, the sac being so low down in the thigh and so little under control. Nevertheless, it should be tried, with the adductors relaxed, by means of steady pressure applied downwards in the hollow of the thigh, and inwards between the adductors.

FIG. 283.



External view.

FIG. 284.



Internal view.

Obturator hernia.

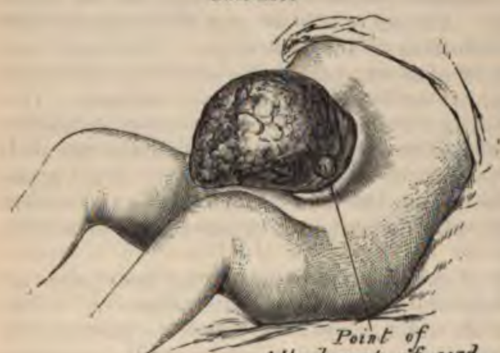
To explore the parts, an incision should be made below Poupart's ligament, and to the inner side of the femoral vein, down to the pectineus muscle, which may then be divided. If no sac appear, and the obturator foramen covered by its muscle be reached, the fibres of this muscle must then be separated and the obturator canal found; for a small hernia, as proved by the case I have recorded, may be well hidden by the muscle. When a sac is felt, the parts constricting it must be divided by a knife and its contents reduced. The obturator nerve, if possible, should be avoided.

UMBILICAL HERNIA.

This may be a congenital or acquired affection, and is common in children from want of closure of the umbilicus. It is far from rare in fat women, and others who have had many children. It is also met with in men, forming 5 per cent. of all cases of hernia, and 6 per cent. of cases of strangulated hernia.

The congenital form.—Children are occasionally born with a hernial protrusion of some of the abdominal viscera into the umbilical cord, the covering of the viscera consisting of the thin translucent sheath of the cord; this deformity is probably due to an arrest of development. Among the few examples of this affection that I have seen was one in which the liver projected, and in it the serous covering subsequently granulated, contracted, and so pressed the parts back into their normal position that a recovery followed. Fig. 285 represents the case in the fifth month. In the case of a male child, one day old, in which a hernia into the cord the size of a small egg existed, and through the thin walls of which the cæcum with its appendix was clearly visible, I pressed the bowel back with my finger and thumb, stitched up the cord at its umbilical orifice with some deep sutures, and ligatured the cord itself at the apex of the congenital translucent hernial sac, and complete recovery followed without any bad symptoms. The child was alive and well two years after the operation. The case was brought to me on June 16th, 1876, by an old dresser, Dr. W. Cock, of Peckham. The practice adopted in the case is that which I advise to be followed.

FIG. 285.



Congenital umbilical hernia.

In the acquired form of hernia, the *sac* is always formed, both in the infant and adult, by the pushing forwards of the parietal abdominal layer of peritoneum. The parts covering it being occasionally very thin, are only integument and fascia, the internal abdominal fascia being over the true sac; at times the tumor attains a large size, and, as it generally increases *downwards*, the surgeon must look for the neck of the sac at its upper part. These herniæ at times assume odd shapes.

TREATMENT.—When in an infant and reducible, a cure may with some confidence be promised; indeed, with the majority of cases in young life an opening in the navel will contract, if care be observed to fix over the part with good strapping a *flat* elastic ring or pad covered with leather. A convex pad tends to keep the ring open. A belt or truss in early life is a delusion since it never keeps its place. In lieu of a pad, it is an excellent plan to pinch up the integument over the hernia with the thumb and finger and then to turn the folds sideways upon the umbilical opening, fixing it in its position by waterproof strapping, the folded integument by this method acting as a pad and assisting recovery.

Messrs. Lee, Barwell, and Wood have suggested an operation for the closure of the umbilical orifice, but such a measure cannot be recommended; since to risk life unnecessarily for an affection that is mostly curable by time and natural processes assisted by art, is hardly justifiable.

Adult patients with reducible ventral hernia should also wear some mechanical appliance, such as a ring truss; and an irreducible rupture should be protected by a cup truss.

When these tumors are large and irreducible, they give rise to troublesome abdominal symptoms. They supply, indeed, the best examples seen of so-called obstructed hernia; fæces and flatus entering the incarcerated intestine and remain immovable, causing nausea, colicky pains, and constipation. Rest in the horizontal position, the local application of ice, a good enema to empty the lower bowel, and a purge to clear out the upper, will often, under these circumstances, prove of great benefit; and should be tried in all cases.

When symptoms of strangulation exist, such measures, however, must not be thought of. The taxis should then be employed, and with a patient under chloroform, as a rule, it proves successful. In applying it to a large tumor where it is probable a fresh descent of intestine has taken place, and the symptoms are due to its strangulation, the surgeon should examine the tumor carefully, to discover if one part is more tense than another; as then the taxis should be applied to the tense part in preference to the other. On several occasions, by adopting this practice, I have been able to reduce with complete success the strangulated portion of the contents of a hernia. When vomiting, constipation, local pain, and an absence of impulse in the tumor are persistent, the reduction or freedom of the mass from strangulation by operation must be entertained.

When herniotomy is called for, it is a matter of immense importance that no manipulation of the contents of the sac should take place, because when the sac is opened and the parts exposed, it is an exceptional occurrence for a cure to follow, no cases of hernia under these circumstances being more fatal than the umbilical. When the sac is not opened, however, so as to expose its contents, or only opened at its neck to allow of the division of the strangulating orifice, a good result may be expected.

In many cases in which I have adopted this practice a good result followed, the oldest patient being seventy-four years of age, with strangulation of five days' standing.

In irreducible hernia of large size and of long standing, when reduction of the contents of the sac, as a whole, cannot be expected, and there is no evidence of strangulation within the sac by some of its contents, the surgeon should be satisfied with relieving the strangulation by dividing the neck of the sac, and leaving the case to nature. To explore the whole sac, and to expose the irreducible bowel to the air and manipulation, is an unnecessary as well as fatal practice. I had a case in 1874, with Mr. Brockwell, of Sydenham, in which, in a lady, an irreducible hernia of seven years' standing became strangulated, when I simply divided the neck of the sac and left the parts alone. After two days the whole contents of the sac returned, and a rapid and complete recovery took place. I have followed this practice on several occasions with a similar result. A *double sac* is found at times in umbilical hernia. Some time ago I was called on to operate in such a case. The woman was aged 44, and had been ruptured for years, the hernia being irreducible. She came under my care at Guy's, with symptoms of two days' strangulation. The rupture was clearly inflamed, the slightest manipulation causing intolerable pain. Under chloroform I cut down upon the tumor, and found two distinct sacs, their orifices, which were placed laterally, being separated by a piece of dense fibre tissue. One contained a mass of omentum, the second, intestine, which was black from congestion and covered with lymph. The orifices of the sacs were freely divided and their contents left, but the patient died, and no examination after death was allowed. In another case, I found strangulated bowel in a small omental sac introduced into an irreducible hernia.

A ventral hernia is a term applied to any protrusion through the abdominal walls not belonging to the usual forms. Most of these are found in the linea alba above the navel. One of the largest I ever saw was over the right iliac fossa; and followed a rupture of the abdominal muscles caused by a fall of twenty feet upon the handle of a pump. It was the size of a man's hand, and strangulated. By the taxis I reduced the mass, and, by the use of ice locally and opium internally, the man recovered. He had, however, subsequently to wear a pad to support the part.

After the operation of ovariotomy a very large protrusion may take place, if a good belt be not worn. The same may arise after the weakening of the abdominal walls from abscess.

When the hernia takes place below the xiphoid cartilage it is called *epigastric*, and in the loins, *lumbar*. Birkett quotes two such cases. In 1875 I saw an example of the epigastric form with Mr. Treves, of Margate, in a lady æt. 68, who had at the same time an irreducible umbilical hernia. Symptoms had existed for 108 hours when I operated, and the bowel slipped back unseen on dividing the parts at the neck of the sac. The patient, however, sank.

Perineal hernia descends in front of the rectum and appears in the perineum, and is most common in women. When the hernia descends outside the vagina along the ramus of the ischium, it shows itself in the labium, *labial* or *pudendal hernia*, and when it appears in the vagina, *vaginal hernia*.

Vaginal and labial herniæ may be mistaken for the mucous cysts of those parts; but the herniæ are reducible, and, when irreducible or strangulated, they give rise to symptoms indicative of these conditions. The cysts are only local affections, and cause no general symptoms. They are tense, elastic, globular tumors, fixed in the tissues, and have *no neck* passing upwards into the pelvis.

Ischiatic hernia is a hernia through the sciatic notch, above or below the pyriformis muscle. The gluteus maximus muscle covers it in; but, as the hernia enlarges, it may appear below the lower border of that muscle. Dr. F. C. Crosse, in Sept. 1875 ('Dublin Journal of Medical Science'), has recorded an interesting example of this kind in a woman, æt. 40. The tumor occupied the lower border of the right gluteal fold, it was the size of a fœtal head, soft and pulpy to the touch, dull in parts, tympanitic in others; and coughing gave an impulse to it. It was treated by a truss. When such a rupture becomes strangulated an operation must be performed, the surgeon making such an incision as will best expose the tumor and its neck.

Diaphragmatic hernia is met with as the result of an accident (traumatic), and is generally fatal; it has been alluded to under the heading of "Abdominal Injuries," page 434. It may also be the result of some "congenital" defect, or the pushing of the abdominal viscera through a natural or other opening in the muscle (acquired form). It rarely calls for surgical aid.

ON TRUSSES.

A truss is an instrument employed for the purpose of preventing the descent of a hernia. It is composed of a pad, to be placed over the seat of the hernial protrusion, and a spring or belt to keep it in position. Any truss that will keep up the hernia under all circumstances, and does not cause pain or lasting discomfort, is probably beneficial. Every truss that fails to carry out this object, should be condemned. An instrument with a too feeble spring is a delusion and snare; but one that is too powerful may tend to do more eventual harm than present good by causing absorption of the abdominal parietes upon which it presses, and, as a consequence, enlargement of the opening through which the hernia descends. For the same reason a pad that is unduly convex is also to be condemned.

A truss that will keep up one hernia may fail in the case of another. Every hernia, in fact, requires a special adaptation of the pad as well as a carefully regulated spring.

Every subject of a hernia, young or old, male or female, should wear a truss, and, in a good proportion of cases, particularly of the young, a cure may take place; that is, the neck of the sac may close. But even after a cure, or apparent cure has taken place, it is well, for the sake of safety, to wear the instrument; as cases are far from infrequent, when a supposed cure had taken place, and after the lapse of years, a sudden descent has occurred, jeopardizing life. This is the more common in the congenital form of hernia.

The truss should be worn all day, from the act of rising out of bed to that of retiring, as its object is to prevent the descent of the hernia under any sudden act of exertion, and, with the truss off, it is impossible to guarantee that any such may not be made. Some patients have a habit of removing their trusses when they are sitting in their drawing-room, but this is to be condemned, since I have more than once been called upon to treat a strangulated hernia which came down under these circumstances, during some unguarded act; and it is in these unguarded moments that the truss is calculated to be of so much benefit.

When the truss is first applied, it will doubtless cause inconvenience, which will soon pass away. The use of plenty of starch or violet powder, the bathing of the point of pressure with some spirit and water, and attention to keep it very dry, are excellent remedies for any little local source of discomfort.

The pad.—This should be regulated according to the size of the hernial aperture. A small opening requiring a small pad, and a large opening, a large one. The pad should always overlap for about half an inch all round the hernial aperture, and in large herniæ, for more. It should be slightly convex when made of any yielding material; and flat, when of a firmer consistency. It should also be so adapted to its spring as to keep its place under all circumstances.

In inguinal hernia it should, moreover, be so fixed to the spring as to exert a pressure at right angles to the plane of the hernial aperture. Thus, in large pendulous bellies, the pressure may be upwards, or inwards and upwards; but in thin subjects directly backwards. In femoral rupture, the pressure should always be backwards, in order to close the crural ring. Any truss that applies its pressure only in one direction must fail in its purpose in a large number of cases. It is, indeed, in this curve of the spring, or direction in which the pressure of the pad is employed, that the chief difference in the great varieties of trusses is found.

Some pads are rigidly attached to the spring that holds them in position, while others are connected by means of movable joints of different construction. Salmon and Ody's well-known truss has a ball-and-socket joint.

The spring of a truss is a matter of importance, although not so much as the pad and the direction of the line of pressure. Its strength should be carefully regulated according to the requirements of the individual case. It ought to be strong enough to keep the pad in position, and prevent the descent of the hernia under all circumstances, but not so as to cause pain. The French spring consists of a coil like that of a watch-spring, is always in action, and presses inwards. The German form is more rigid and inelastic, and holds the pad firmly in its place, thereby resisting the protrusion of the hernia under any expulsive effort. The English makers employ a variety of springs. A too rigid one, as the German, is not to be recommended, whilst the French is also objectionable, its action being too severe and constant.

The best is that which holds the pad in position, keeps it there under all movements, counteracts any expulsive action of the hernia, and causes little if any discomfort. The lighter it is under these circumstances the better, and the closer it is adapted to the body the more comfort it affords.

The only truss that has no circular-body spring, and is kept in position by a band is the Moc-main lever. The pressure is kept up by means of a thigh strap attached to a small spring-lever connected with the pad. Such a truss is doubtless comfortable, as its action is not enough to produce inconvenience, but it is not safe under most circumstances. In old people where the inguinal rings require only a little support, it may be used; but in the middle-aged, when the hernia has a tendency to come down, it is a dangerous and unreliable instrument.

In **oblique inguinal** hernia the pad of the truss should be placed *over the internal ring and canal*, and not over the external ring, the object being to give support to the weak internal ring; in **direct inguinal** it is placed over the external ring. In **femoral** hernia, when the crural arch is natural and not relaxed, a small pad may be employed over the neck of the sac; but when the arch is relaxed and movable, a large pad, so adjusted as to press upon the ligament itself, is required. After the operation of herniotomy for crural hernia, this fact is worthy of attention; for when a free division of Gimbernat's ligament has been made, the neck of the sac is always large and the ligaments relaxed.

To give a description of every variety of truss is needless.

Egg's truss is in all respects rigid, and keeps its place when once fitted. *Cole's truss* is very good, is light, and has a thin metallic pad covered with leather, and acted on by spiral rings. When properly adapted with a not too convex pad, it gives elastic pressure, but is not so well calculated to retain a hernia under violent exertion as another truss with a more solid pad; the elastic pad being apt to yield and allow the hernia to descend. This objection applies to all elastic pads, although air or water pads, in some cases, are very comfortable and valuable, particularly in the healthy aged subject.

Among the trusses with solid pads that of Wood's must be mentioned. They are made by Matthews, with flat pads, composed of wood, ivory, or vulcanite, an india-rubber water-bag being occasionally applied to the surface of the pad. They are held in position by a spring that encircles the body. The size of the pad varies with the nature of the hernia, and the size of the hernial aperture. For oblique inguinal hernia, the pad is of an obliquely curved horseshoe shape, the outer limb over Poupart's ligament being shorter than the inner, and the spermatic cord and pubic spine lying in the cleft. The curve of the horseshoe is placed over the inner hernial aperture. For direct inguinal or umbilical hernia, the pad is made the shape of an ovate ring with a hole, corresponding to the hernial opening in the centre. For femoral hernia, the pad is egg shape.

Newsom's truss has a thin round wire-spring and a hard pad, which is very comfortable when well adapted.

The truss of Dr. C. Edwards, of Cheltenham, is good, the pad being so arranged that it may revolve as well as slide on the spring when required. That of Salt, of Birmingham, and L'Estrange's, are also good instruments. Millikin, of St. Thomas's Street, makes also an excellent truss with a pad, which, being movable upon a ball-and-socket joint, is really adapted to any case.

A simple, yet a very efficient truss has, for some time past, been made by Messrs. Krohne and Sesemann, designed by Mr. R. Rendle, late surgical registrar at Guy's, for keeping up either a single or a double rupture. It consists of a circular steel spring covered with vulcanite, and made to fit the pelvis closely, an inch below the hip. At both ends of the spring there is a slot in which vulcanite pads slide, one for the left and another for the right side. If a hernia exists on one side only, the spring pressure on that side is made the strongest, the pad on the other side acting as a protection from rupture.

Whatever truss is selected to be of use it must answer to a nicety the purpose for which it is required. The pad should be adapted to the abdominal hernial orifice or to the hernial tumor itself, and not below it. The amount of pressure applied to the pad ought to be carefully regulated as well as its direction, and enough employed to keep the pad in position under all circumstances, without causing pain. A slight force applied in the right direction being of more value than a greater misdirected.

The pad may be flat or slightly convex, and made of a solid or elastic material. Of the latter, air, water, or springs may be employed, according to the requirements of the case. Sand pads are of great value, as they can be moulded to fit more comfortably and accurately than any other.

To test the value of a truss.—The patient should be made to cough and strain, and, when possible, to jump. He should be placed on the edge of a chair with his legs apart, or made to stoop forward with his knees apart and his hands resting on his knees and then to cough, these positions tending more than any other to relax the lower parts of the abdomen and to loosen the truss. When the hernia by these means fails to descend or to excite in the patient a sensation of weakness in the region of one of the abdominal rings, the truss is probably efficient. The patient should be taught, under all circumstances, what the truss is expected to do, and be made to understand the danger he will incur if it fail in its purpose, as well as the necessity of again seeking advice.

The surgeon, moreover, should always take upon himself the responsibility of seeing that the truss fits, and not rest satisfied by sending his patient to buy a truss where he likes and of what kind he likes; he should also tell the maker what is wanted, and not leave him to find it out.

To measure for a truss.—The following points should be noticed, viz., the nature of the hernia, the size of the hernial aperture, the side, or if double. The circumference of the pelvis should also be given one inch below the crest of the ilium, and the girth of the body, commencing and ending at the hernial orifice, as well as the distance from the hernial aperture to the iliac spine. The surgeon, moreover, should always indicate to the maker the directions of the pressure required by the pad, and this should always be made out when the patient stands, by a digital examination. In pendulous and fat subjects with inguinal hernia, it may be upwards, backwards, and inwards; in thin subjects simply backwards. In femoral rupture, the plane of the crural ring is horizontal, and may be closed by a backward pressure. No general rules can be laid down, though this is a point upon which the whole value of the truss depends.

To estimate the force required to keep the hernia in position is a difficult matter. Up to the present time the only true test is that of trial. Mr. Wood has had an ingenious pressure-gauge made for the purpose, which may possibly turn out of value. ('Brit. Med. Journ.,' October 12th, 1871.) Mr. Holthouse has likewise invented a skeleton truss which promises to be of use for indicating the length and shape of the spring required, and the correct angle at which the pad should be fixed.

Patients who are liable to employ at times great muscular exertion should have two trusses, one for ordinary wear with a sufficient press power to keep the hernia in position, and the second with an increase of power which is to be put on when occasion demands. They should also have extra bathing trusses.

When any tendency exists for a double hernia, as indicated by a bulging of the opposite ring or a sense of weakness on making exertion, a double truss should be worn; indeed, in inguinal hernia, I believe that a double truss should always be employed. It is at least as comfortable as a single one, besides being an extra protection if well adjusted, and can do no harm.

Birkett, 'Holmes's Syst.,' vol. iv, ed. 1870; 'Med.-Chir. Trans.,' 1859.—*Bryant*, 'Guy's Reports,' 1856; 'Clin. Surg.,' Part 3, 1861.—*Cooper's* 'Surgical Dict.,' 8th ed.—*Gay*, 'On Hernia,' 1848.—*P. Hewett*, 'Med.-Chir. Trans.,' 1844.—*Hutchinson*, 'Lond. Hosp. Rep.,' 1865.—*James*, 'On Hernia,' 1859.—*Aston Key*, 'On Hernia,' 1833; 'Guy's Rep.,' 1842.—*Kingdon*, 'Med.-Chir. Trans.,' 1864.—*Luke*, 'Med.-Chir. Trans.,' vols. xxvi. and xxxi.—*Lawrence*, 'On Ruptures,' 1835, 5th ed.—*Stephens*, 'On Obstructed Hernia,' 1829,—*Scarpa*, Wishart's ed., 1814.—*Ward*, 'On Strangulated Hernia,' 1854.—*Wood*, 'On Rupture,' 1863.

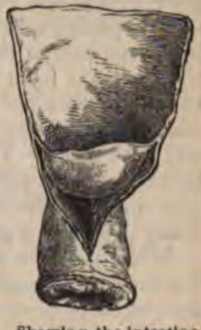
CHAPTER XVI.

SURGERY OF THE ANUS AND RECTUM.

(MALFORMATIONS.)

THE anus and rectum are not rarely the seat of congenital malformations, and these show themselves in a variety of forms. In one class of cases the anus is completely closed, the rectum being either partially or wholly deficient; in a *second* the anus exists in its normal condition, but opens into a *cul-de-sac*, the rectum being partially or wholly deficient (Fig. 286); and in a *third* the anal orifice is absent, the rectum opening into the bladder, urethra, vagina, or other abnormal position. And, it will be observed, says Mr. Curling, to whom we are indebted for the bulk of our information on this subject ('Med.-Chir. Trans.,' vol. xliii), that the classification of these imperfections is founded on states that can generally be recognized during life; although, unfortunately, the conditions of the terminal portion of the intestinal canal, and its relation to the parts around, cannot be predicted with any certainty; since in cases of imperforate anus, or of anus opening into a cul-de-sac, the intestinal canal may terminate in a blind pouch at the brim of the pelvis, the rectum being wholly wanting; or, an imperfect rectum may form and show itself as a short sac descending to the floor of the pelvis, or to the neck of the bladder in the male, or commencement of the vagina in the female. An explanation of these different conditions is to be found in the fact, that these malformations are clearly due to some failure in the fœtal development and to the want of junction of the two ends of the rectal tube; for the *anal* portion of the bowel developing from below, grows upwards, while the *intestinal* descends from above. The two parts subsequently advance, and, in a natural condition, unite, the membranous diaphragm at the point of their junction, at a later period, disappearing by interstitial absorption. When a failure in this uniting process takes place, the second class of congenital imperfection is formed; when the failure occurs at an

FIG. 286.



Showing the intestine ending as a cul-de-sac above the anus. Prep. 1882^{74}, Guy's Hosp. Mus.

early period of development, the two ends of the approaching tubes will be far distant, and, when at a later period, they may be in closer contact. The closure of the anal orifice is due to a firm adhesion of the integument.

Sometimes the blind pouch in which the intestinal canal terminates is connected with the anal integument, or with the anal cul-de-sac, by a cord prolonged from the bowel above, and it seems possible, from Curling's and MM. Goyrand and Friedberg's observations, that such cases are caused by an obliteration of the bowel which was originally well formed, from some intra-uterine inflammatory action; instances being on record where the muscular tissue of the intestine was clearly traced into the cord. Where the upper bowel communicates with the urinary or vaginal passages, it is owing to the incomplete separation of the natural cloaca that exists during the development of those parts.

A clear understanding of the way in which these deformities are caused will explain the difficulties that are met with in their treatment.

TREATMENT.—On the birth of every child, the condition of the different outlets of the body should invariably be examined, and even when the anus appears normal, a digital examination should be made on the second day, if the bowels have failed to act, as many an infant's life has been lost for the want of this attention and the consequent postponement of surgical relief till too late a period.

In the *simplest* cases when the anus is closed by a thin membrane and the bulging of the distended rectum indicates its nature, a cautious central incision through the soft parts should at once be made, and a good result is generally obtained, the power of the anus usually being complete. Mr. R. Harrison, of Liverpool, records the case of a child who was born with an imperforate anus, and was successfully operated upon in the anal region *thirty-three days* after birth. ('Lancet,' Feb. 26th, 1876.)

In the *more complicated* cases where the anus is closed or absent and *no bulging of the bowel exists*, where the surgeon has no means of making out the true position of the terminal end of the bowel, a cautious incision may be made over the spot in which the anus ought to be found, the finger of the left hand acting as a pilot, but this must be carried out with care. The incision may be free as long as it is carried upwards and backwards towards the sacrum, and not forwards towards the urethra or vagina. It must not, however, be made too high. Where there is not sufficient room to carry out this practice, the coccyx may be cut away.

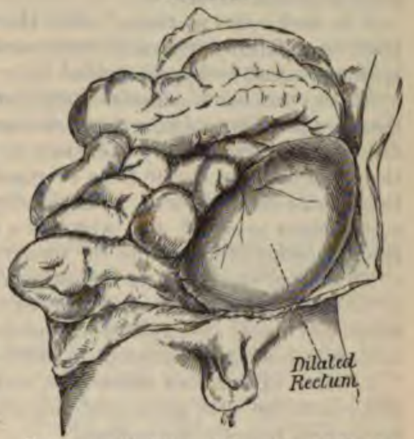
When these means fail, all further attempts must be relinquished. To introduce a knife or a trocar and canula blindly upwards with the vain hope of puncturing the distended bowel, is a practice to be unhesitatingly condemned. Mr. Curling's figures, too, prove that the perineal exploratory operation unless undertaken with great care, does more harm than good; though when skilfully performed it is followed by considerable success.

In the treatment of the second class of cases, when the rectum terminates above in a cul-de-sac, an exploratory operation may be made as just described, but the uncertainty as to the true position of the bowel renders any operative proceeding hazardous. When the two tubes are in contact and only separated by their membranous ends, as in the case illustrated (Fig. 286), a good result may be expected, but, when they are far apart, no such success can be anticipated. Mr. Curling in his table gives 31 examples of this class of cases. In 27 an attempt was made to reach the bowel, in 16 with success, while 10 of these subsequently recovered.

When the bowel is opened in any of these cases and is not far from the anus, the surgeon should use all fair endeavors to draw down the intestine to the margin of the external opening and fasten it with sutures to the skin. He cannot often, however, succeed in accomplishing this, the bowel being rarely found at a less distance than an inch from the perineum; but when possible, the advantages of the practice are great. Where this cannot be attained, repeated dilatation of the perforated bowel is absolutely essential to maintain its patency, as otherwise, like all artificial openings, its subsequent contraction will take place. The introduction of a finger once or twice a week is sometimes sufficient for this purpose, and in a case I had under my care, where the tendency to contract rapidly was marked, the introduction of a large sea-tangle tent answered admirably, the tent being placed in water for a few minutes beforehand to make it swell.

When the anus opens in an abnormal position, as in the vagina, and the anus made by the surgeon is established, there is a natural tendency for the abnormal opening to close, several cases being on record in which this result ensued. Two have occurred in my own practice. When success has followed any operative procedure in these cases, it is important that close attention should be paid to the condition of the bowel for many years, and indeed for the whole of life, because there seems reason to believe, that the bowel which forms the upper cul-de-sac has but little muscular power, and is liable to dilate under fecal collection as well as to become paralyzed, death under these circumstances taking place from obstruction. In Fig. 287, this fact is illustrated. It was taken from William L—, æt. 26, who had been operated upon as an infant for an imperforate rectum. He died in June, 1874, from exhaustion and peritonitis following intestinal obstruction, this obstruction being clearly due to the narrowing of the rectum at the seat of the early operation. At the post-mortem, the rectum was found to occupy half the abdominal cavity and was thirteen inches long and eleven in circumference. Its walls were three times as thick as natural, more particularly the peritoneal coat.

FIG. 287.



Enormous dilatation of the rectum following obstruction due to the contraction of an artificial opening made into an imperforate rectum twenty-six years previously.

When the exploratory ano-perineal operation has failed to give relief, or when it is inexpedient to make the attempt from the very backward position of the genital organ, other measures must be adopted, and of these the opening of the large intestine through the abdominal wall is certainly the best. M. Rochard, in the 'Mémoires de l'Académie Impériale de Médecine,' 1859, gives ten authentic successful cases of Littrè's operation in the groin for this affection. Holmes informs us, in his admirable work 'On the Surgical Diseases of Children,' that he had not met with the account of any permanently successful operation since the publication of Rochard's paper. Guersant opened the colon in the groin eleven times in succession, and once in the loin, without saving a patient. Giraldès, however, had one case in which a child lived two months and a half and then died from another cause.

The operation, to be successful, must be undertaken early, before the infant is exhausted and peritonitis set in. Delay is only justifiable when the bowel is not distended and the symptoms not in any way urgent.

With respect to the form of operation, that known as Littrè's is probably the best, viz., opening the bowel in the groin. The left groin is usually selected, although the right has been recommended by Huguier on account of the frequent bend in the colon towards the right groin, and the absence of the rectum in these cases. Giraldès also has shown from dissection, that in thirty infants operated on for imperforation, the intestine was found on the left in all. ('Nouveau Dict. de Méd. et de Chirurg. pratiques,' 1864.) I have on three occasions performed Huguier's operation with temporary success. In the last case, operated upon in December, 1876, the child (a male) was twelve days old before relief was sought, and he lived eight days, dying from chronic peritonitis, which had evidently existed before the operation. The artificial anus had been made in the lower part of the large intestine, and, had the operation been performed at an earlier period, good success would probably have been attained. The question is, therefore, still *sub judice*. Amussat's operation in the loin is rightly put aside in these cases on account of the natural looseness of the colon after its splenic flexure. Figures likewise help towards the same conclusion, since out of fourteen instances in which Littrè's operation was performed, nine recovered, whereas two only out of seven recovered after the lumbar operation.

The operation itself has been described in page 450.

In the treatment of the third class of cases, where the rectum opens into the vagina, the surgeon may lay open the rectum from the position of the natural anus, having previously passed a director into the vaginal orifice of the gut as a guide, drawing down, when possible, the bowel, and fastening it to the integument by sutures, as originally performed with success by Amussat. As a guide to the perineal incision, a bent probe may be passed into the vaginal orifice of the bowel, and the end turned towards the perineum, cutting down carefully upon it. I have done this with success on four occasions, and in all stitched the bowel to the margin of the integument, forming a good anus. In two cases, the vaginal orifice subsequently closed. In two, that were operated on several years ago, the patients have good control over their motions, while the vaginal fecal fistula seems to be contracting, liquid motions alone passing.

In exceptional instances the deformity seems to cause no inconvenience. Ricord has recorded one ('Gaz. des Hôp.,' 1863) in which the woman was married and her husband was quite unconscious that anything abnormal about the parts existed. Le Fort has recorded a second in which the woman was married, and had had three children, the malformation having been accidentally discovered in an examination for some suspected disease of the bowel.

"In such cases as these," adds Holmes, "the termination of the rectum in the vagina must be tolerably free, and there must either be an external sphincter or the internal sphincter must be hypertrophied."

When the *bowel empties itself into the bladder or urethra*, the case is very hopeless, though the prospects of a successful issue are better under the latter than the former conditions. An exploratory operation in the region of the anus may, however, be made with the usual caution, in the hope of reaching the intestine, and, on its failure Littre's operation should be performed. Mr. Curling has related a successful case of this operation in a boy, eight years of age, who had a good anus in the groin, yet suffered from the occasional passage of feces into the urinary passages.

By way of summary the following conclusions may be given :—

1. In all cases, with some rare exceptions, of imperforate anus, obstructed rectum, or misplaced anus, an exploratory operation in the normal anal position ought to be made, success following the attempt in nearly half such cases.

2. Such exploratory operations, however, to be successful, should be undertaken early, and conducted with great caution—the line of puncture or incision being upwards and backwards towards the sacrum.

3. When these means fail, or are inapplicable, the intestine must be opened in the groin, it being still an open question whether the right or left side ought to be selected, though the latter is the usual one.

4. When an artificial anus has been made, its constant dilatation is a necessity.

For further information on this subject refer to Curling's paper, 'Med.-Chir. Trans.,' vol. xliii, and French edition of Holmes's 'Surgical Diseases of Children,' by Dr. Larcher. Bodenhamer, Wm., 'On Malformations,' Wood, New York, 1860. Ashton, 'On Rectum,' 3d ed. 1860.

INJURIES OF THE RECTUM.

The anal orifice and lower part of the rectum may be wounded by accident from falls, or by design, and, when this occurs, hemorrhage is a common result. Repair, however, rapidly goes on in these regions, and with the arrest of bleeding by either securing the divided artery or by pressure, and water dressing, a good result may be anticipated.

In 1876, a severe example of this kind came under my care at Guy's Hospital, in a boy æt. 12, who was impaled upon a rail, the iron spike entering the pelvis on the inner side of the right tuberosity of the ischium, perforating the rectum about two inches up, and lacerating the anterior wall of the rectum and base of the bladder. The injury was followed by collapse and attended with hemorrhage. I saw him directly after the accident and made a free incision into his bladder as for lithotomy, in order to secure a free passage for the urine; it being clear that the recto-vesical peritoneal pouch was lacerated. Some though not severe peritonitis followed; and feces passed per anum as well as through the external wound. On the sixteenth day I consequently gave opium to lock up the bowels, with the view of making a splint as it were of the feces, and to keep the rectum and intestinal wound quiet. Success followed the practice and the wound in the bowel closed. After four days, the bowels were opened after a dose of castor oil, and convalescence became established.

In parturition, the rectum is sometimes laid open by a rupture, either alone or with the perineum, and, when this occurs, the rent ought to be brought together at once, for if this practice be not adopted, a plastic operation subsequently will have to be performed.

In the *act of defecation*, small lacerations of the anus are not uncommon, when the motions are very large or hard; and H. Mayo ('Dis. of Rect.,' 1833) relates the case of a lady who, during a violent effort at defecation, felt something give way, and, on the following morning, discovered feces in her vagina. An examination revealed a rent two inches up the bowel large enough to allow the end of the finger to pass from the rectum into the vagina. Cases are also on record, when, during parturition, a child's head passed into the rectum and was delivered per anum.

In the milder forms of laceration of this kind, cleanliness and laxatives, as a rule, are sufficient to allow the parts to heal. In some instances, the rent does not heal and the case becomes one of fissured anus or painful ulcer of the rectum, and should be dealt with accordingly.

Wounds of the rectum inflicted by the surgeon, as a rule, heal readily, as is fairly proved by the cases of fistula in ano treated by operation, and the recto-vesical operation for stone. The puncture made in the operation of tapping the bladder per rectum for retention also heals quickly.

It is well to remember, that the rectum may be wounded by the passage of a bougie, enema syringe, or the introduction of an O'Beirne's tube. Guy's Museum contains specimens illustrating all these forms of injury, and, at St. Bartholomew's, there is a specimen of perforation of the rectum by a metallic clyster pipe, through which gruel was injected into the peritoneal cavity.

Foreign Bodies in the Rectum.

These may be introduced from *without*, either from mischief or accident, and trouble may be experienced in their removal, their shape and position influencing the result. More commonly, however, they have been swallowed, and have passed down the canal, becoming caught or impacted in the rectum. They are not unfrequently the cause of anal abscess; bones, pins, bristles, &c., being constantly found in the rectum under these circumstances. Stones, hairs, or husks may likewise form concretions that are foreign bodies. When large foreign bodies have been introduced into the rectum, or concretions or solid masses of feces become there impacted, chloroform should be given to allow of their removal, care being taken not to injure the walls of the bowel more than can be helped. With the patient under the influence of chloroform, the sphincters become so relaxed as to allow of the introduction of large instruments, or even the introduction of the hand to guard the bowel and remove the foreign body. Bottles, pots, cups, corks, rings, pencil cases, bougies, sticks, &c., have been impacted in these regions, and considerable care is needed in their removal to prevent injury. The injection of plenty of warm oil before the attempt greatly facilitates the operation. Lithotomy scoops or forceps are likewise valuable, but the ingenuity of the surgeon is necessary in every case to apply the best means to carry out the end in view.

A large collection of such cases with their treatment is given by M. Morand in 'Memoirs of the French Academy of Surgery,' vol. iii, and by Ashton in his work 'On the Rectum.'

Diseases of the Anus and Rectum.

These have only recently received sufficient attention from the great body of surgeons, and, as a consequence, have been too often allowed to fall into the hands of "quacks;" and, although able and respectable specialists have since rescued this important class of cases from their hands, much remains to be done by the profession as a whole, to bring the diseases of these parts into their right position, that is, into the hands of the general practising body of the profession. Again, in no class of cases are so many mistakes met with, and these almost always arise from a want of proper local examination of the parts. The anus or rectum is either unlooked at or unexamined from some mistaken notions of delicacy, or badly examined from want of knowledge or want of inclination. But such should not be, and every patient who complains of anything like persistent symptoms in those regions should be as carefully examined as he or she would be were any other locality equally affected. To do this, some nicety is required, and, to help the student, the following hints may be acceptable.

Examination of a patient.—The best position is on the side with the legs well drawn up and thighs flexed upon the abdomen, the hips being brought to the edge of the bed or couch in a good light; the surgeon, with one hand having uncovered the parts sufficiently to expose them, may then raise the upper buttock, and in doing this, the anus comes well into view; in operations, this may be done by an assistant. When an abscess exists, it will then be seen; if a fistula be present, its external orifice will be apparent. Fissures, warts, condylomata, or fleshy, flattened, cutaneous vegetations, or cancerous tubercles, will also be at once recognized.

Pendulous loose folds of skin about the anus will suggest the former existence of external hemorrhoids; blue, turgid, venous projections their present existence. A tightly contracted and rigidly drawn up anus, as a rule, means some painful ulcer of the part, and a patulous anus through which flatus or discharge passes without the patient's wish, too often indicates extensive rectal ulceration or stricture.

Internal piles when prolapsed will appear as turgid, vascular, mucous projections, covered with mucus or blood, surrounded by everted integument more or less œdematous; *prolapsus* recti, as a greater or less annular projection of smooth or rugous mucous membrane, with a central intestinal orifice. A *polypus* projecting will appear as a cherry, surrounded by healthy structures. All these points are taken in at a glance, and understood. A digital examination should then be employed to confirm or refute the suggestions thus taken in by the eye. To do this well, the index finger must be thoroughly anointed with lard or ointment, it being a good plan previously to fill the nail with a piece of soap. It should then be applied to the anus, and the patient told to bear down, as in doing this the sphincter is relaxed. The surgeon can then with ease, and without pain, introduce his finger. When an ulcer exists at the anus, pain will be caused by, and spasmodic resistance offered to, the introduction of the finger, and, with the pulp of the finger slowly moved round the anus, the ulcer will probably be felt. It should be stated, however, that in many cases, this ulcer will be seen by a careful drawing down of the skin of the anus till the margin of the mucous membrane becomes visible. A spongy nodular feel of the mucous membrane just within the sphincter will suggest internal hemorrhoids; a local, tender, and raw surface, the probability of a simple ulcer; a circular, indurated raw surface that of a syphilitic sore, while a cancerous ulcer is known by an infiltrated nodular and thickened surface. A stricture within two inches of the anus can always be detected by its annular form or the obstruction which it causes. When a healthy piece of bowel separates the anus from the stricture or ulceration, the probability of the disease being cancerous is rendered great. When no such healthy tissue exists, syphilitic disease is rendered probable. A digital examination will always detect the presence of scybala or impacted feces, and also the encroachment of uterine or pelvic tumors in women, and prostatic tumors in men. To confirm these opinions thus formed, a speculum may be used, which should be introduced, well warmed and greased in the same way as the finger. Mr. Curling says, "when the mischief is high up in the rectum let the patient stand on the left leg, with the right thigh and leg bent, the foot resting on a chair. Tell the patient to strain. This action will then force the parts down." I have found this method of examination serviceable.

Mr. Allingham "advises the prone position, with the hips well elevated upon hard pillows, to such an inclination that the intestines will gravitate towards the diaphragm, so that when expiration takes place the rectum becomes patulous, and you can see as far as the sigmoid flexure perfectly distinctly." This mode of examination, he informs us, was suggested by Dr. Marion Sims. ('On Diseases of the Rectum,' 1871.)

The speculum represented in Fig. 288, as made for me by Krohne, is the one I prefer.

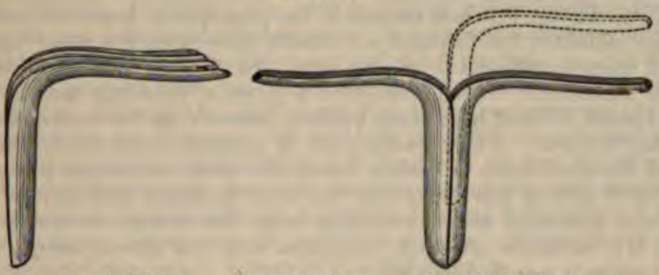
The practice of introducing the whole hand into the rectum has been frequently adopted by several good surgeons, and, from my own personal experience, I believe it to be of value, more particularly for diagnostic purposes, in cases of suspected disease of the rectum above the brim of the pelvis, in pelvic or abdominal affections. In the female patient, it is more readily performed than in the male. The operation, however, is neither easy nor free from risk, since laceration of the rectum has been recorded. It should be performed with the patient under the influence of an anæsthetic, and with extreme slowness (five minutes may well be spent in passing the sphincter ani); the hand should be well greased and introduced with a screwing motion. When the hand has passed within the rectum, much care is required, and, when the narrowness of the gut forbids easy advance, no force should be employed, for by force the peritoneal covering of the bowel has been ruptured. With the hand in the rectum, the parts above the brim of the pelvis may be readily examined; indeed, the kidneys have been felt, and pulsation in the larger branches of the abdominal aorta can be traced, and consequently controlled.

With these brief general remarks, I now proceed to treat of the special affections.

FISSURE AND PAINFUL ULCER OF THE ANUS.

This most distressing affection produces more misery than any other local disease with which I am acquainted, and renders the natural act of defecation an agonizing one, often "causing great drops of perspiration to course down the temples." It is usually caused by the mechanical splitting of the orifice of the anus from the passage of a large or indurated motion, at the junction of the mucous membrane of the bowel with the skin, although it is not always traceable to such a cause. In some instances it seems to owe its origin to scratching the parts when highly irritable. It is usually a disease of adult life, and common to both sexes; though it has been found in children, even so young as a year and a half. ('Brit. Med. Journ.,' June 6th, 1874.) It is met with as often in the healthy as in the feeble subject, but where it has been allowed to go on uncontrolled, it soon tells upon the strongest patient. Constipation, high feeding, sedentary habits, and want of local cleanliness, are the common causes, but anything that sets up irritation in the intestines is likely to produce it, and, when once started, unless treated with discrimination, it may go on for years; indeed, it is by no means unusual to hear that the symptoms have been endured for two, four, or even six years. It generally manifests its presence by some local uneasiness in the act of defecation, this uneasiness passing on to more or less severe pain. This pain, as a rule, is experienced during the passage of the motion, but in some instances it comes on after the lapse of a few minutes or even an hour or more after the act, and may last a few minutes or hours. When it passes away, the patient is easy till the same cause excites the same symptoms. The motions will often be streaked with a line of pus or blood and diminished in size, sometimes being flattened, at others pipe-like, and this diminution is produced by the spasm of the sphincter, the size of a motion being, in disease as in health, greatly determined by the condition of the sphincter.

FIG. 288.



A nest of three. Rectal speculum. Two adapted for use.

On examining the anus, the first fact that strikes the observant eye is the unnatural resistance the patient makes on separating the buttocks; and, on doing this, the powerful contraction of the sphincter that will be visible. On attempting to introduce the finger, considerable resistance will be encountered, and the greatest pain caused if the surgeon persevere in his attempt.

The symptoms and local signs of the affection are indeed so characteristic that the true nature of the case can, as a rule, be diagnosed without the aid of a digital *internal* examination; and a careful *external* examination will often reveal the presence of an ulcer on the verge of or within the sphincter; when within, its outer border will be visible. The ulcer is usually, though not invariably placed at the posterior margin of the anus, and is rarely larger than a sixpence, if so large. When recent, it will be soft, with slightly elevated edges; and when of long standing, indurated with an irregular surface, small polypoid growths fringing its border. The ulcers are at times multiple, in exceptional cases involving the bowel higher up. It is an affection of the mucous and submucous tissue, and painful only from its position, besides being obstinate in healing from its connection with the sphincter ani. Simple fissures of the anus rarely involve other than the mucous membrane and skin around the parts, and are often associated with piles, though occasionally with small polypi. Ulcers are often hidden from view when piles or folds of skin exist about the anus, but pain indicates their presence.

In women, this affliction is so often associated with reflected uterine symptoms as to be frequently overlooked, and in men, urinary irritation may mask the disease. Reflected nerve pains in the perineum and down the leg, as in sciatica, or in the loins, as in lumbago, &c., are often induced by the affection.

TREATMENT.—Happily for patients, the treatment of this disease is as successful as it is simple. *Simple fissures* are readily treated by the administration of a laxative, the local application of the nitrate of silver or of lead lotion mixed with the extract of opium, and local cleanliness, with simple, nutritious, and unstimulating diet. When the parts are indolent, or syphilis suspected, black wash may be used, or calomel dusted over the part or applied as an ointment, five grains to a drachm of lard. In other cases, the application of mercurial ointment with the extract of belladonna gives relief. Injections of the decoction of rhatany twice a day, or of an enema composed of a drachm each of the extract and tincture of rhatany in five ounces of water are sometimes of great use, as also iodoform as an ointment, ten grains to the ounce.

When a larger *ulcer exists*, the cause of spasm and pain, and is quite recent, the same treatment may be employed; but, when the ulcer has existed for any time and has a hard base, it is quite exceptional for a cure to take place by these means, the surgeon being hardly justified in making the attempt, when he has at hand such an efficient means as *the division of the base of the ulcer with the superficial fibres of the external sphincter.* This can be done in many cases by the introduction of the finger with a probe-pointed bistoury pressed flat upon it, to the upper margin of the ulcer, and the division of the base of the ulcer by turning the edge of the knife towards the surface of the ulcer and then incising it. Boyer, who first suggested the principle of treatment, advised the free division of the sphincter, but Copland and Brodie introduced the minor operation, which in the bulk of cases is sufficient to effect a cure. In very chronic instances, Boyer's operation may be demanded. When chloroform is given, a speculum may be used, and the ulcer being exposed, divided by a sharp bistoury, transfixing the tissues at the base of the ulcer on cutting inwards. The essential point of practice to observe is, the free division of the base of the ulcer down to healthy tissue, the mode of doing it being unimportant. When any fold of skin or pile exists near the ulcer, it should be removed. The *forcible dilatation* of the sphincter, and its laceration with the thumbs in the rectum, as practised abroad, is a barbarous treatment compared with the above, though when a patient is under chloroform it may be followed.

In the after-treatment, the bowels must be kept slightly loose, and for this purpose nothing equals in value a mixture of one ounce of olive oil, rubbed down with forty-five grains of carbonate of potash, and mixed with seven ounces of peppermint or chloroform water, one ounce being given two or three times a day to produce a soft evacuation. Indeed, before as well as after the operation, this mixture should be employed; when it fails, enemata ought to be used. The diet should be simple and rest maintained till the cure is complete, for where this rule has not been observed, I have known the ulcer becomes so indolent as to require a second division, which, under other circumstances, is rarely required. Tonics are often of value during the convalescing period.

Spasm of the sphincter is not a disease but a symptom, caused by reflected irritation from some rectal, uterine, or other local affection. It may be a small or superficial ulcer beyond the verge of the anus, the presence of worms, the existence of a small polypus, or some other cause of irritation of the mucous membrane lining the bowel, but a local cause will be found after careful investigation.

The same remarks are also applicable to *neuralgia of the rectum*, though it is quite reasonable to believe that a pure neuralgia may occur of this part as of any other. Yet, as a rule, it is caused by reflected irritation from some nerve with which the part is connected, and the surgeon should clinically so regard it. It is said to be common in gouty subjects, and can certainly be relieved by free purgation.

Dr. T. Ringer, an able surgeon in the Indian army, has related to me several cases of this complaint clearly caused by malaria, and cured by large doses of quinine.

ANAL ABSCESS AND FISTULA IN RECTO.

The two subjects of anal abscess and fistula in recto are classed together, as the latter disease is almost always preceded by the former, though a large number of cases of anal abscess recover without passing into a fistula. Of my notes of 236 consecutive cases of the two diseases, 43 commenced and ended as anal abscess, while the remaining 193 were treated as fistula in recto; 74 of these cases were females, and 162 males, men being evidently more liable than women to this affection. It rarely occurs in children, though I have successfully treated a case in a male child four months old, and a second in one of fifteen months; in the latter the fœtor of the discharge was very great.

Of the causes of this disease, little positive information can be given, because, as a rule, the abscess is obscure in its orgin, slow in its progress and repair; some patients even professing to have been unconscious of its existence till it was about to burst. In other cases, however, they are very *acute* in their action, and very painful.

That an anal abscess must always result from some ulceration of the bowel within the sphincter is an opinion which can scarcely be regarded as true, there being no evidence to support such a view, and the fact that so many as forty-three out of 236 cases of anal abscess recovered without forming a fistula goes far to prove its error. It is not unfair, therefore, to infer that in many cases, it depends upon a different cause.

In fistula in recto this argument must be equally strong, since it is generally believed that this affection is merely the sequel of the anal abscess; we must, consequently, look for some other and more general cause than that ordinarily received, namely, perforation of the bowel from ulceration.

The mechanical irritation of a foreign body is doubtless an occasional cause, it being by no means uncommon for a surgeon to remove from the anus, when opening an abscess, a piece of fish-bone, bristle, or other foreign body. Quite recently I removed a pin.

These affections may occur at any period of life, though I have seen a fistula in a child six months old, and, in the majority of instances it is found in adults between twenty and forty years of age. Dr. Lipscomb, of St. Albans, related a case to me which took place in his practice that was congenital, the mother having conceived when worrying about her husband, who was suffering from fistula. It is very common to be informed that the fistula had existed for several years before surgical aid is sought.

With respect to the connection between phthisis and fistula, it is difficult to give any positive information. During the eight years that I was registered at Guy's, I inquired carefully into this point in every case, but had only 3 out of 193 in which either hæmoptysis or other symptom of marked phthisis was present. In the majority of cases, the patient presents no more severe cachectic symptoms than is usually met with in other hospital patients, and I confess to being somewhat doubtful as to the fact, that in fistula in recto is a common consequence of phthisical disease. When, however, fistula and phthisis are associated, the former is usually of a bad form.

When a fistula has two openings, one externally and the other into the bowel, it is called *complete*. When there is an external but no internal opening to be found, it is known as the *blind external*. When an internal but no external, *blind internal*.

That as a rule an internal opening exists is now scarcely doubted, although at times there may be great difficulty in finding it. M. Ribes in 1819, examined the bodies of seventy-five people who died with fistula, and in all he found an internal opening; in nearly all, this was placed just within the sphincter, but in no instance was it higher than half an inch. Modern surgeons now accept these facts. The pus that forms in these parts is very offensive at times, as often from the absorption of fetid gases through the mucous membrane as from the mixture of feculent matter. In a large number of cases, the discharge has no fecal odor.

It should always be remembered that an anal fistula may accompany severe rectal disease, such as stricture or ulceration, or that it may be connected with disease of the pelvic bones, &c. In the case of an old man with an enormous abscess between the base of the bladder and the rectum, constitutional symptoms are very severe till two deep incisions were made on either side of the perineum, giving exit to a quantity of pus, when an excellent recovery ensued. In this instance it was a question whether the prostate gland was in fault, but no other symptoms of such a complication could be ascertained.

TREATMENT.—In cases of anal abscess *free incision* is the best practice, which should be made as soon as fluctuation can be felt externally or through the bowel. Deep-seated abscesses in these regions should not be left to natural processes to open. When the abscess is in front of the anus and rectum, an early opening may be called for on account of the retention of urine to which it may give rise. The incision should be made from without inwards, in a line radiating towards the anus. In deep-seated abscesses, one or two fingers may be inserted well into the rectum, and the abscess pressed forwards before the incision is made, a sharp straight bistoury being the best instrument to use. A piece of oiled lint should be inserted into the wound, and kept there for a day.

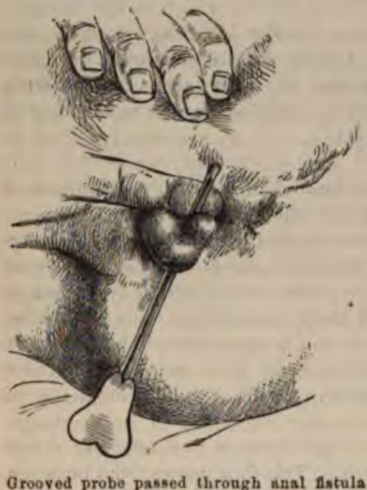
In a case I saw, in 1872, owing to the neglect of making an early opening, emphysema and phlegmonous inflammation of the perineum, scrotum, penis, and abdomen even up to the axilla took place, a free communication evidently existing between the bowel and the abscess. The patient died from the constitutional irritation of the disease. The sloughing of the cellular tissue was very extensive and the fœtor of the sloughs was something to remember.

After the abscess had been opened, the patient should be kept at rest in the horizontal posture, water dressing applied to the wound, and the most perfect cleanliness observed, laxatives being given when the motions are hard, and also tonics to improve the health.

When a *fistula exists*, the best operation is its division into the bowel, the action of the sphincter ani having, doubtless, a powerful influence in retarding repair. The bowels should previously be cleared by a mild purge two days before the operation, and an enema given on the morning of its performance. The patient should be placed on the side upon which the fistula exists, with the legs well drawn up, and brought to the edge of the bed or couch, such position being better than that on the elbows and knees, or the stooping over a chair. An assistant should separate the buttocks. The surgeon ought then to introduce a fine probe-pointed grooved director into one of the fistulous openings, and with the greatest gentleness, guide it through the fistula. Anything like force on the part of the sphincter will excite resistance to its introduction and cause pain. When the end of the probe passes into the bowel through the internal opening, all that is required has been effected, and if difficulty be experienced in doing this, the well-greased index finger of the opposite hand can be carefully inserted into the rectum and the internal opening felt for, through which, when found, the end of the probe can readily be guided into the bowel. When no internal opening exists (a rare condition), the director must be forced through the bowel at the upper part of the sinus.

As soon as the director is felt in the rectum, the patient should be told to strain, the surgeon, at the same time, with his index finger hooking its end downwards. By these means the director will be made to protrude from the anus, when the whole of the tissues bridged over can be readily divided (Fig. 289).

FIG. 289.



Grooved probe passed through anal fistula before its division.

When the fistula runs high up and much force is called for to turn the probe out of the anus, it is better to pass a speculum and to divide the fistula.

When a long sinus runs up by the side of the bowel, it should be laid open through a speculum, to leave it alone not being a safe practice—for, although in some cases a cure may take place, in many the discharge into the rectum will continue and but little good will have been effected by the external operation. The presence of this internal discharging fistula is generally indicated by the appearance of pus upon the motion.

When many sinuses exist, they should be laid open, although it is not necessary to divide the sphincter in more than one place, as a double division of the sphincter is apt to be followed by incontinence.

After operation, the wound should be well plugged with dry cotton wool down to the bottom, and no careless introduction of the plug will suffice. By this measure, all bleeding can be controlled, and any amount of pressure applied by means of a T bandage. When no bleeding exists, only a moderate-sized plug is necessary.

On the second day, the dressing may be removed, there being no occasion to reintroduce the plug, a piece of oiled wool or lint gently introduced to absorb discharge being all that is required. The wound should be kept clean. When indolent, it can be stimulated by some lotion of nitric or carbolic acid, terebine, or tincture of iodine; tonics and good diet being also valuable. The horizontal position, not in bed but on a sofa, must be maintained, however, till the parts are healed.

In the *blind* internal fistula, a guide to the external wound may often be found by means of a bent probe hooked through the internal opening, and the case treated as any other.

Where severe bleeding complicates the case, a speculum may be passed, and the vessel seized and twisted. Where this cannot be done, the rectum may be well plugged with a sponge saturated in alum; but, as a rule, a well-applied pad and pressure, adjusted with a T bandage, are sufficient to control it.

A piece of ice put into the centre of a cup-sponge, and applied to the anus not only arrests bleeding, but gives great comfort in this as in almost all anal operations.

When a cutting operation is inexpedient, as in "bleeders," or, when the patient will not submit to it, the division of the fistula with a metallic wire, heated by the galvanic cautery, is a faultless method. Indeed, in all cases of fistula, where this apparatus can be obtained, it is the best means. It readily divides the tissues, the two ends of the wire being made to project through the two orifices of the fistula, thus burning their way out with a sawing movement. There is little pain at the time, and scarcely any after, with no loss of blood, and, what is more, no need of any subsequent dressing, as a cauterized surface must heal by granulation.

When this plan cannot be followed, the treatment by ligature has been adopted. Mr. Luke revived the practice in 1845, but it has now fallen into desuetude. Were I called on to adopt the practice, I should use an india-rubber ligature.

In rare cases, fistula may be treated by injection, a daily injection of the sinus with some tincture of iodine, sulphate of zinc, or nitrate of silver, having been followed by a cure; yet such cases are too exceptional to justify the recommendation of such treatment.

When the patient's condition is such as to forbid any hope of repair in the wound taking place, the operation for fistula should be set aside; but the existence of pulmonary mischief, if not far advanced, is no argument against its adoption; nay, it may be made use of as an argument in favor of surgical interference—recent investigations, as already alluded to in an early chapter, having indicated that the long existence of suppuration is liable to set up tuberculous disease. Practically, however, it is undoubtedly true, that fistula may be divided, and heal in far from healthy subjects, and the general health improve after the operation.

HEMORRHOIDS OR PILES.

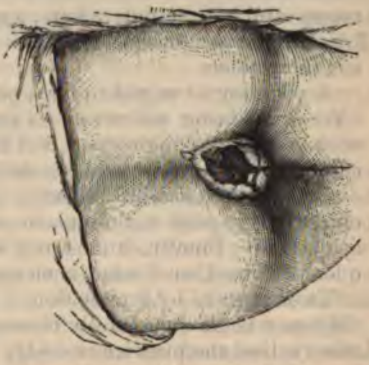
In a clinical point of view, these may be divided into the "*bleeding*" and "*non-bleeding*." The *former* are generally the *internal*, and composed of a highly vascular tissue, involving the mucous membrane of the rectum and the submucous tissue, with enlarged arteries and veins. Where the arterial element predominates, the tumor has a bright red strawberry aspect; where the venous, a dusky hue. They are closely allied to nævoid structure and discharge arterial blood.

The *non-bleeding* or *external* piles are composed of the loose folds of skin that surround the anus; or a varicose, inflamed, or ruptured vein. When inflamed, these folds become œdematous and infiltrated with organized inflammatory products, and appear as fleshy growths of various degrees of density. The venous hemorrhoids also become swollen, and appear as bluish, tense, and painful tumors. When in an active state, they may encroach upon the mucous membrane of the rectum and appear as large as a walnut, but, as a rule, they are about the size of a nut. They rarely give rise to much annoyance when cleanliness is observed; but, under other circumstances, they cause much local irritation. When swollen or inflamed, however, they give great distress from the sensitive conditon of the skin at these parts. External piles also are occasionally the cause of hemorrhage, the blood at times coming direct from an ulcerated vein, and is then venous. At other times it will be profuse, but its exact seat is not so evident. The flow comes from between the pendulous flaps of skin, and ceases when they have been removed.

The TREATMENT of these external piles is simple, and excision is the only radical cure. The pendulous flaps of skin that surround the anus may be removed with a pair of sharp scissors, the tumor having been drawn forward with a pair of forceps. These incisions should be made in lines radiating towards the anus. When coagulated blood has been poured out into the pile and a tense painful tumor exists, it may be punctured or laid open with a lancet; bleeding, when it occurs, being easily arrested by cold and moderate pressure. When the pile is inflamed, leeching often gives comfort, and the application of a poultice, covered with the extract of opium gives relief. When the part suppurates, the abscess may be opened.

In the early stage of the affection, local cleanliness, the abstinence from highly seasoned food and strong wines are mostly sufficient, the bowels being kept clear by enemata, or the occasional dose of a mild aperient, such as the compound rhubarb pill before dinner, some saline purgative water or electuary. When local irritation exists, an ointment composed of equal parts of zinc, nitrate of mercury, and subacetate of lead is very valuable, some recommend also the compound gall ointment. An ointment of zinc and the extract of belladonna is very useful.

FIG. 290.



Internal hemorrhoids.

Internal piles are very insidious in their growth; so insidious, indeed, that bleeding is often the first symptom that attracts notice. On inquiry, however, it may generally be made out that constipation has been the normal condition, and that irritation about the anus, with a feeling of heat and fulness in the parts, had previously existed. These piles often appear after parturition. When the parts *inflame*, there will be throbbing, and pain in defecation; when they *protrude*, there will be one, two, three or more masses of thickened mucous membrane with nævoid structure, presenting either a smooth and tense, or a reticulated surface. Sometimes there will be oozing of blood from the whole surface, or the blood may spurt from a distinct orifice. The blood is almost always red and arterial, and the mucous projection is surrounded by skin, more or less pendulous, œdematous, or infiltrated with inflammatory products (Fig. 290).

When the parts are not inflamed, this hemorrhoidal mass may protrude only during defecation, and return naturally, or, after a little pressure. When the disease has been of long duration, the pile may protrude on the slightest exertion, even on the patient assuming the erect posture or on coughing; the whole mucous membrane of the rectum often participating in the prolapse, and adding to the discomfort.

The pain attending the development of these piles varies vastly, small hemorrhoids often giving rise to severe local distress, while the larger cause but little. An inflamed pile is, however, always painful, and a prolapsed, strangulated, inflamed one the most of all. Where pain is excessive, and more particularly after defecation, there is a strong probability that a *fissure or ulcer* complicates the case.

The amount of *hemorrhage* bears no proportion to the extent of the disease. In one of the worst cases of hemorrhage I ever saw, in which a lady was blanched and almost pulseless, the pile was not larger than half a nut; it was of the reticulated kind, and the blood spurted out from a vessel as large as the radial artery. On the removal of the pile, a complete recovery ensued. On the other hand, it is remarkable to what an extent the local disease may develop in some cases without producing excessive bleeding.

The bleeding, as a rule, takes place after the action of the bowels, and covers the motion; occasionally it precedes it; but in many instances, it is quite independent of all action of the bowels, blood flowing on the patient assuming the erect posture, or at odd times without any such cause.

The amount of blood said to have been lost, under these circumstances, is somewhat remarkable, writers upon these subjects relating the loss of "three chamber-potfuls," "eight or nine pounds," &c. Doubtless, in many of these accounts there is exaggeration; still, all surgeons must, at times, be astonished at the loss of blood that takes place in these cases daily, sometimes for years, but with little apparent interference with the general health.

The discharge of a thick mucus from the anus is a frequent accompaniment of this affection, and of a muco-purulent secretion when *ulceration* complicates the case.

Urinary irritation, and at times *retention*, in both male and female subjects, often add to the distress, and in women *womb* complications produce the same effect.

Nerve pains passing upwards to the loins, hips, and round the sacrum, or even downwards to the heel and sole of the foot, are likewise met with. Brodie gives a case in which the heel pain was the most prominent feature.

What are called dyspeptic symptoms are almost always present, the assimilating organs suffering as well as the circulatory and nervous systems.

This affection is usually met with after puberty. In early life, men are probably more liable to it than women, but, after forty-five, both appear equally liable.

Constipation has probably an important influence in causing the disease and certainly in increasing it, but sedentary occupations and high living appear to have a stronger effect. In the prosperous classes of society this malady is said to be common, although in the poor, daily hospital experience does not help to confirm the notion that it is rare. Whatever tends to retard the flow of blood from the hemorrhoidal veins, such as pregnancy and abdominal tumors, aggravates the disease, and whatever tends to keep up irritation in the rectum, such as drastic purgatives, worms, and pungent food, acts in a similar manner.

A pile may be mistaken for a polypus, but the smooth, firm surface and pedunculated form of the latter will reveal its true nature. Again, a ring of piles might be confounded with prolapse of the rectum, but the uniform smooth and generally non-bleeding surface of the latter, with its broad attachments, ought to be enough to prevent the error.

External piles when ulcerated may also assume very much the aspect of venereal anal outgrowths, which can be made out only by the history of the case and other clinical symptoms. Finally, it must not be forgotten, that hemorrhoids may be merely a consequence of another disease, such as stricture of the rectum.

TREATMENT.—All piles do not require removal. In the early period of their growth they may be so successfully treated by what is called *palliative* treatment as to render more active measures unnecessary; and, in the very cachectic and diseased, it may not be expedient to do more than relieve; although it must be added, that unless organic disase exists to threaten life, there are few general conditions of a patient that forbid the moval of a severe bleeding pile. Again, when piles occur in plethoric subjects who re, perhaps, what has been described as apoplectic or gouty, and an attack of them is receded by constitutional disturbance and followed by relief, the surgeon should be careful o checking suddenly the flow of blood, as such a measure is undoubtedly sometimes fol-owed by alarming constitutional symptoms, though such cases are rare.

The *palliative* or *general* treatment of piles means attention to diet; the giving up of igh living, and the taking of simple nutritious food in moderation, beer and spirits in articular being avoided.

The bowels should be regulated by the *Mistura Olei* already described (p. 500), or by astor oil, rhubarb and magnesia, or some saline medicine or mineral water, such as ichy, Friedrichshall, or Pullna, and when these fail, by enemata. Indeed, the daily nema of cold water or the use of the rectum plug through which cold water is allowed o flow is of great value. Violent purgation, more particularly by aloes and colocynth, hould be avoided. Some prescribe copaiba, but its nauseous qualities forbid its general se. The confections of senna or sulphur are useful, and that of black pepper (Ward's paste) has been always popular. A mixture of confection of senna ℥j, confection of ulphur ℥j, powdered guaiacum ʒij, and treacle, is very beneficial. Dr. Cleland recom-mends ('Practitioner,' Jan., 1876) the use of the liquor bismuth ʒij, mixed with ℥j of starch, as an enema, to be used at night in prolapsus recti. In piles, both in the child and adult, drachm doses of glycerine, combined with 15 grains of citric acid and some vegetable bitter three times a day, may be administered.

When the secretions of the liver and intestines are unhealthy, a little blue pill or gray powder and chalk at bed-time are sometimes of use, some bicarbonate of potash in gentian or calumba assisting recovery.

Absolute local cleanliness should always be observed, and the recumbent position assumed after defecation, the prolapsed pile being always reduced at once by gentle pressure. By these different means an attack of piles may pass away never to return, or to do so after a long interval; but even in the worst cases relief may be given.

When the piles are inflamed the application of leeches occasionally gives great relief, bleeding being encouraged by hot fomentations; such means, however, are rarely called for, the complete washing out of the lower bowel, rest, and fomentations being generally sufficient. In some cases the application of ice in a cup-sponge gives more relief under these circumstances than any other remedy.

When the prolapsed internal piles are strangulated by the sphincter spasmodically contracting around the mass, sloughing of the whole may take place. Under these circumstances, great pain is caused by the tension of the parts, and on one occasion I was tempted to cut off with scissors some of the projecting portions, when the relief was so marked that I would repeat it under the same circumstances, though to adopt this practice with safety, the pile must be in the condition that precedes its death. When this sloughing takes place, a cure may follow. During the sloughing process, a poultice is the best application.

The mucous discharge from the bowel in long-existing piles can only be met by enemata and the application of astringents, an ointment of tannic acid ten grains to the ounce, of gall and opium, or of extract of rhatany, half a drachm to the ounce of lard or spermaceti, being good local applications. The occasional introduction of a suppository of tannic acid into the rectum is likewise a valuable expedient; and an enema of alum or tannin, five grains to the ounce, is also serviceable. Allingham speaks highly of an ointment of the persulphate of iron half a drachm to one drachm of the unguentum cetacei, or, as a lotion, twenty grains to an ounce.

SURGICAL TREATMENT.

Unless the general condition of the patient forbids, all piles, external or internal, should be removed, when they not only give local annoyance, but by the hemorrhage produced they upset the general health of the patient and induce weakness. To accomplish this many means are at our disposal.

External *hemorrhoids* ought to be removed by abscission.

Internal piles ought never to be excised, but destroyed by the galvanic or actual cautery, or ligatured. In the hands of many surgeons the ligature still holds its ground, but with as many it has been nearly, if not altogether, superseded by the cautery. In a few cases nitric acid is of service. I have used the ligature only in exceptional cases for at least fourteen years. In Paris, a plan of treatment has been successful, which claims attention, as it receives the support of M. Verneuil. It consists of forced anal dilatations, either by the thumbs of the surgeon or by means of a dilator, the piles withering after one full dilatation of the anus.—('Union Médicale,' March 6, 1877.)

The ligature.—The hemorrhoidal tumors having been made to protrude by the patient straining over a stool containing hot water, or by an enema of warm water, he should be placed on his side with his legs drawn up and the parts well brought into view by an assistant separating the buttocks. The surgeon should then grasp the base of the tumor that is to be ligatured by a pair of forceps such as that figured (Figs. 291, 292), and separate the pile from the skin and submucous tissue by scissors, subsequently transfixing it with a needle armed with a double ligature either of silk or hempen cord. He should then divide the cord and tie the pile tightly in halves, cutting off with scissors half at least of the strangulated portion before finally tightening the second ligature; a second or third mass should be similarly treated, the ends of the ligatures cut off, and the whole then returned within the sphincter. The surgeon should be careful to include in his ligature all the diseased tissue, and when this has not been done with the forceps, it is better to pass a needle or tenaculum through the base of the pile higher up, round which the ligature may be looped, than to remove the forceps and reapply it. He should also take care not to include any of the external skin.

Fig. 291.

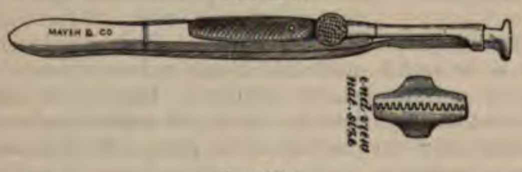
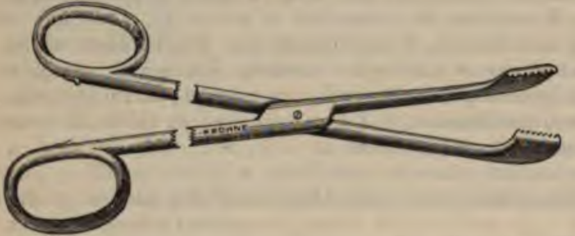


Fig. 292.

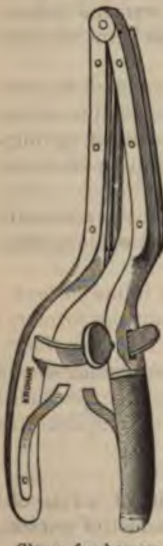


The ligatures may be expected to separate about the seventh or tenth day, and they should always be allowed to slough off.

After the operation an opiate may be given or a full dose of chloral (half a drachm). The bowels should be left undisturbed for at least two days, when a dose of castor oil or other purge may be administered, or, better still, an enema. The horizontal position must be maintained throughout the case. If œdema of the parts follow, ice may be applied, or a lotion of lead and opium; belladonna rubbed down with glycerine at times gives relief. Until the bowels act the diet should be simple, nutritious, but not stimulating. This operation is successful, and has no special danger, though it is, perhaps, more tedious than the treatment by cautery, and more painful.

The cautery.—When internal piles require removal, the clamp and cautery are, without doubt, the best means to employ, and the thermo cautery, or the *galvanic* cautery when it can be obtained, is preferable to the *actual*. Cusack, of Dublin, suggested this practice in 1835; but Henry Lee and Henry Smith have done more to establish it than any other surgeons. It is adopted as follows: The patient having been prepared as for the ligature and the piles protruded, the anus is to be dilated forcibly, with the view of allowing free manipulation of the piles, as well as of preventing subsequent spasm of the sphincter. Each mass is then to be seized seriatim with the vulsellum forceps, drawn down and secured at its base by clamps (Fig. 293, a modification of Curling's, being as good as any), the upper end of the clamps presenting towards the anus. The projecting half of each mass must then be cut off with scissors, the surface wiped dry, and the cautery, heated to a white heat, applied to the surface; the whole projecting portion being burned down to the level of the clamp, a dense eschar is thus formed. When the thermo or galvanic cautery cannot be had, the actual cautery iron ought to be employed, a second being at hand to use as the first cools.

Fig. 293.



Clamp for hemorrhoids.

The eschar is more solid and firm after the thermo or galvanic than after the actual cautery; it is likewise followed by less pain, the heat being so intense as to destroy all sensibility. Ample experience with both has convinced me of this fact.

As each mass is destroyed, the clamp should be removed, care being taken not to disturb the eschar. When all have been treated, with the finger well greased the whole projecting mass may be returned into the rectum, it being a good plan at this moment to return with it a suppository of morphia to soothe pain.

The patient should be kept at rest for at least a week after this operation, but they will often be anxious to go about much sooner, saying that they feel quite well. A fortnight is the average time for convalescence, but a week in good cases seems sufficient. In one of the worst cases of internal piles I ever treated I applied the clamp to four masses and burned them down as described with the galvanic cautery. After the first day all pain had gone; on the fourth the bowels acted naturally without the slightest inconvenience, and in a week the man was up, no single drawback having taken place. Such a case, however, is exceptionally good even for the cautery.

The after-treatment is the same as in ligature, the local application of ice, perhaps, giving greater comfort.

In not a few examples of internal hemorrhoids, where one or two sessile masses alone existed, I have, by means of a speculum, without the aid of a clamp, applied the galvanic or thermo cautery to their surfaces direct, and in others I have merely punctured them. Nothing but good results have followed the practice, and I am disposed to think in such cases it is the best to adopt. A good sound eschar forms at once, and, on its removal, a recovery takes place.

Demarquay ('Gaz. de Paris,' 1860) merely passed a hot iron over the surface of the pile to produce a superficial eschar. He advised also linear écrasement where the piles only protrude on defecation and can be replaced, where the sphincter is not relaxed, nor the mucous membrane of the rectum prolapsed. In all other cases he prefers the cautery.

When nitric acid is used, the patient should be prepared and treated in the same way as for the cautery; the acid should be applied with a piece of wood to the diseased surface instead of the hot iron. The spoon-shaped clamp forceps are probably the best to use under these circumstances. After the application of the acid the parts should be well oiled and returned. This practice was suggested by Dr. Houston, of Dublin, in 1857. To small, flat, strawberry-looking internal hemorrhoids, this plan of treatment is very applicable, but is not so satisfactory as the cautery. I never now employ it. Ulcerating piles may be treated in the same way as others.

When a fissure or painful ulcer co-exists with hemorrhoids, its base should be divided before the operation for hemorrhoids is undertaken, or, what is better, lacerated by forcible dilatation of the anus.

In operating on internal piles the surgeon must be careful not to take the everted and possibly œdematous skin that encircles the mucous homorrhoidal mass for external piles, and remove it. This should on no account be touched. Pendulous external hemorrhoids can also be taken away at the same time.

In rectal operations when an anæsthetic is employed, the patient requires to be brought completely under its influence, and in this condition the surgeon loses the valuable aid a patient can give in protruding the hemorrhoidal mass, consequently a greater dragging force is necessitated to bring the parts well into view. On the whole, as large operations are painful and somewhat tedious, it is probably advisable to use the drug.

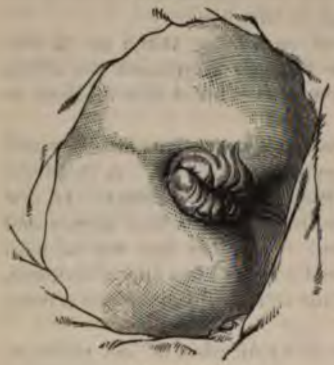
Local anæsthesia in these operations is worse than a delusion except for the removal of external piles, but it is of use to assist their reduction when inflamed and œdematous, and to give relief after operation.

With respect to the danger of operating, it is but small; fatal cases have followed both the ligature and cautery, though the advocates of the latter say it is safer than the former. Mr. Henry Smith, who has operated oy the actual cautery in 400 cases, had only four deaths. On the whole, the operation for piles is a most satisfactory one, and contains no greater element of danger than any other.

PROLAPSUS RECTI.

This is met with in every degree of severity, from the mere protrusion of a ring of *mucous membrane* through the anus (Fig. 294) to the prolapse of even a foot of *entire bowel.* In children a mild form is very common; but it is usually a symptom either of some urinary irritation, such as a stone, or that caused by a long or adherent

FIG. 294.



Prolapsus recti.

prepuce; worms, constipation, dysentery, a polypus, or any rectal irritation may likewise induce it, as may a cough in very feeble subjects where the sphincter has lost its tone. One of the worst cases I have ever seen in an adult was due to the existence of a villous polypus high up the rectum, the straining accompanying the affection and the hemorrhage being very severe, but a rapid recovery ensued on the removal of the growth. In another case, that of a lady, where the bowel had come down for sixteen years accompanied with daily hemorrhage, and in which walking was rendered impossible from the extent of prolapse (about six inches of bowel) the removal of the mucous membrane in three portions by clamp and cautery rapidly effected a cure.

To ascertain the true cause of the affection, consequently, is the first aim of the surgeon, the treatment being then comparatively simple. On its removal the prolapse rapidly disappears.

TREATMENT.—Whenever the bowel comes down it should be returned, which can usually be readily effected by placing the patient in the recumbent posture and pressing with oiled fingers flat upon the part. In children, the utmost gentleness should be employed, for with pain, resistance is produced, and with it increased difficulty in reduction. Under all circumstances the patient should be kept in the recumbent posture. The bowels should in children be relieved lying down, and in adults, the horizontal posture ought always be assumed after natural relief. Brodie advised nocturnal relief of the bowels to be encouraged with this object. When the parts have been down for some time, the greatest trouble is often experienced in their reduction, indeed, sometimes it is impossible; although, with the patient under chloroform, success may attend the gentlest efforts when forcible attempts had previously failed. When the bowel had been reduced, a good pad, fastened on with a T bandage will keep it in place, or the nates may be fastened together with some good bands of strapping. When the bowel is inflamed or ulcerated, conditions that soon occur in chronic cases when the patient goes about, some slight scarification may be called for; but the application of cold in the form of ice is probably the best treatment. In some obstinate cases in children, the free application of the nitrate of silver in stick to the whole mucous surface, previously wiped with lint and subsequently mopped, is often followed by its reduction and retention. I have never seen this practice do harm; and one application has cured the disease. The injection of three or four ounces of water made astringent with tannic acid, in the proportion of three grains to the ounce; or, with tincture of iron, ten drops to the ounce; or of the infusion of krameria, or decoction of oak bark, with or without alum, after the bowels have been relieved, is a valuable adjunct; in adults the tannic acid suppository twice a day is useful, as also the application of the tannic acid glycerine before its reduction. A mixture of the solution of perchloride of iron with two of glycerine is likewise a good application. Costiveness should never be allowed, enemata being used to keep the bowels empty, or the mildest laxatives, as rhubarb, castor oil, or some natural saline waters as the Pullna, or Friedrichshall. To give the bowel tone, tonics, as a rule, are required, nux vomica being probably the best, either alone or in combination with iron. I have never employed this drug in children, though some surgeons speak highly of it, as the simpler tonics usually suffice. In children, as an alterative, rhubarb, soda, and calumba mixture is to be recommended. In more severe cases of prolapse, the application of nitric acid in vertical stripes is very valuable, or, what is better, the galvanic cautery similarly applied. In bad cases, it may be necessary to remove three or four vertical folds of mucous membrane with the clamp and cautery, as for piles. Copeland suggested the practice, although he removed the mucous membrane by means of the ligature; Brodie improved upon it by adopting nitric acid; and modern surgeons have still further simplified the treatment by introducing the clamp and cautery, galvanic or actual. Few operations in surgery are more successful than this, and although in children it is probably never acquired, yet in adults it should never be rejected except for the same causes as operations for hemorrhoids. In very extreme cases of prolapse, the linear cauterization of the prolapsed bowel may be advantageously applied.

The treatment of such a case would be precisely similar to that laid down in the last section for piles.

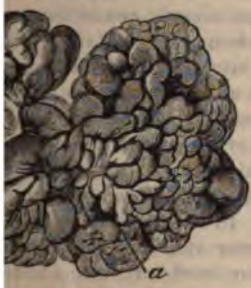
POLYPUS OF THE RECTUM.

so rare a disease as authors would lead us to believe. In the adult it proba-
affection, but in the child it is *the principal cause of hemorrhage from the*
om this fact, cases of polypus have been doubtless put down as those of piles.
is are generally found in children under ten years of age. In hospital prac-
mostly seen in the out-patient department. They appear to be more com-
than in female subjects, since out of eighteen cases I have analyzed from my
urteen were males, thirteen were in children under ten, and five in adults.
n size from that of a pea to a large cherry, and grow from the submucous
covered by the mucous membrane. When far beyond the reach of the
d small, they probably do not cause any inconvenience, though when large,
e rise to straining of the bowel, prolapsus recti, and even intussusception.
orst examples of prolapsus recti I have ever been called upon to treat, was
esence of a fibrous polypus situated some inches up the bowel in a man 50
who had suffered from it for twenty years. He was cured by the removal
1. Mr. Pollock ('Holmes's Syst.,' vol. iv, ed. 2) has given a case in which
on took place, and in another I have to relate the same result ensued. As
sphincter local irritation and hemorrhage are produced, the growth appear-
he anus as a pink or red cherry. Blood sometimes flows from the anus only
tion, at other times quite independently of it. When the polypus is low
s usually with the blood a free discharge of mucus.

a child is brought with these symptoms, a local examination should be made,
s efficiently the surgeon should sweep his finger completely round the walls
having passed it well into the rectum. By doing this, the polypus will be
its attachment and its pedicle made tense. Sometimes several polypi exist
have on one occasion removed three. They are made up of fibro-cellular
more or less fibrous according to the age of the patient; but in the adult,
ement predominates.

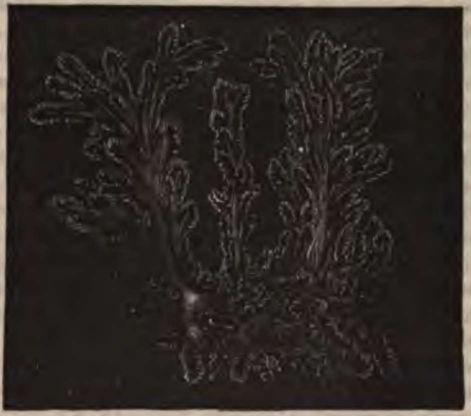
olypus has been discovered, its removal is the only correct practice. In
n I detect them with the finger, I generally manage to hook them down,
so they often break off. I have never seen any bleeding follow this measure.
casions when I have brought the growth external to the sphincter, the action
has broken it away, and in this manner, many cases of polypi are naturally

FIG. 295.



us polypus of rectum.

FIG. 296.



Dr. Moxon's Report on Villous Growths, with drawings.

Vertical section of polypus through the line *a*, Fig. 295, showing vascular simple and compound villi, covered with a columnar epithelium; large vessels in the base on which the villi rest; and sections of the follicles of Lieberkühn. This section represents half the thickness of a lobule of the polypus seen by 1¼-inch power.

n they do not break off, a
be applied to the pedicle,
o cut off the growth after
n beyond the knot. In
igature should always be

moval of the disease the
appear, but when they con-
d polypus will generally be

rowths are occasionally
the rectum as in other parts of the large intestine, and when low down they
violent straining and hemorrhage. This straining may, indeed, give rise to

an intussusception of the bowel, or to prolapsus recti. This was well exemplifed
case of a woman, æt. 43, whom I had under my care in June, 1867. She had
from prolapsus recti after every motion for twenty years, with more or less bleedin
straining at times being most distressing. When I saw her, the bowel was down fo
nine inches; blood was then passing, and the pain was great. I made a careful e
tion, but failed to find anything. I reduced the prolapsus, and prescribed rest.
second visit, with the bowel only down a very little, I examined her again, and
finger could just touch a new growth. With a pair of long forceps I took hold
brought it down, finding a splendid specimen of the villous polypus. I put a
round its base at once, and cut off the growth. No single unfavorable symptom
be recorded subsequently; all her former troubles at once disappearing and a
recovery ensued. In June, 1870, this woman was still well. The growth is il
in Fig. 295, with the microscopical appearances (Fig. 296), and Dr. Moxon's re

Condylomata are also very common about the anus, and are mostly, but not
syphilitic, the irritation of dirt being probably sufficient to produce them. In
they seem to come from the irritation of worms.

Cleanliness, the application of nitrate of silver, and the dusting of their surfa
calomel or oxide of zinc, generally produce a rapid cure. *Vegetations* due to the
of acrid discharges, such as *gonorrhœa* or *syphilis*, require to be excised.

Warty growths are also met with about the anus as on other cutaneous
Sometimes they grow to a great extent and then require excision. I have r
mass the size of a fist.

Pruritus ani should generally be looked upon as a symptom of some rectal
tinal irritation, constipation, or rectal disease. It is always a source of great dis
most distressing being those in which the symptoms occur at night in bed p
sleep. The best application I know for its relief is a cold sponge, and, having
parts, the unguentum metallorum made of equal parts of zinc, nitrate of me
subacetate of lead ointments. Some recommend a lotion of the nitrate of sil
fifteen grains to the ounce. Zinc and opium ointment is also beneficial. The
of cold through the rectum plug may also be recommended. These remedies,
only relieve the symptom; in order to cure it the cause must be found out and

ULCERATION OF THE ANUS AND RECTUM.

The painful ulcer of the anus or anal orifice of the rectum has been alrea
and it remains for us to consider briefly such other forms of ulceration of the
are met with in practice. They may be described as *simple*, *syphilitic*, and
Simple ulceration is by no means unfrequent, and, when not involving the an
rise to symptoms which are usually looked upon as dysenteric. The passage
fæces with blood and muco-purulent discharge are the chief symptoms. The ra
of the intestinal contents through the sigmoid flexure and rectum gives rise
griping pain, but beyond this, there are few general symptoms. On examinin
under these circumstances, a single ulcer will probably be found, but occasion
It may be somewhat indurated at its edges, though its base is not so as a whole.
circular, and at times surrounding half the rectum. In the case of a boy, æt.
my treatment, the surface of the ulcer was so nodular that I should have s
cancerous nature had I met with it in an adult, but in this instance it had
many months, and the granulations had assumed a polypoid nature. It
recovery. These simple ulcers are also likely to perforate the bladder and
recto-vesical fistula. I have had five such cases, and in four, colotomy was
with success, the operation taking away the chief source of distress, viz., the
fæces with the urine—prolonging life, and apparently allowing the ulcers to he
paper by author, 'Clinical Soc.,' 1872.)

These cases can be treated by general means, such as a careful regulation
alkaline medicines with tonics, the administration of laxatives such as the mi
cause and maintain a soft condition of the fæces, and the daily administration
two-ounce enema of starch and opium, or simple oil. The recumbent position
maintained as much as possible.

Under these circumstances a good recovery generally takes place.

When these ulcers [illegible] the anus, they give rise to the same painful sympt
painful ulcer of the [illegible] must be treated in a similar way, viz., by di
superficial fibres [illegible].

hilitic disease of the rectum is a more common affection and is met with sexes though more frequently in women than in men, the disease apparently creep- n the vagina to the rectum. Occasionally it is due, doubtless, to direct introduc- the poison. It appears as a more or less extensive ulceration of the lower two of the rectum ; and, as a rule, involving the anus, as well as passing higher up the . It is a disease of the mucous and submucous tissues, and is indicated in its age by a spongy induration of these tissues, and later by ulceration and the dis- of a highly irritating sero-purulent or sanguineous discharge and by a patulous The anus itself may also be the seat of the lateral, flattened, fleshy, cutaneous out- so common in syphilis, or it may be ulcerated. It is generally a disease of young fe, and associated with some syphilitic history. There is almost always some pain act of defecation, some looseness of the bowels, and discharge of blood, pus, or Anal or vaginal fistulæ sometimes complicate the case. In neglected cases where ation has gone on with spreading ulceration, there may be constipation and some e; indeed, as a cause of stricture of the rectum, this syphilitic disease is by no unusual.

ATMENT.—Recognizing its syphilitic origin, large doses of the iodide of potassium o be given, five grains three times a day, gradually increased to ten or twenty, in itter infusion or bark ; but when tonics are indicated, they may be given in com- n. The bowels should be kept slightly loose by the daily dose of olive oil or castor regulated as not to purge, and the daily employment of an enema of starch or with or without oil, to keep the parts clean and free from the irritation of feces.

recumbent posture should likewise be observed, as well as simple, nutritious, but ky, food taken.

lly, absolute cleanliness is essential. Where contraction exists or is taking place, ly introduction of a bougie anointed with some mild mercurial ointment, such as uentum metallorum, may be used; but for the patient, the daily introduction of a similarly anointed is preferable, candles being made of all sizes. Nothing like ical dilatation should be thought of, as it is dangerous in the extreme. By these a cure may be effected, though such can only be complete after the treatment of . In very neglected or severe cases, a cure is almost hopeless without colotomy. had some striking examples under my care illustrating well the advantages of this on. The recognition of the disease as syphilitic is the main point to be made out. ign authors describe *chancroid* disease of the rectum as venereal and not syphi- ut in this country it is hardly recognized. Such may, however, be found amongst escribed as cases of simple ulceration.

cerous ulceration of the rectum, usually **epithelial,** sometimes villous, arcinomatous, is generally met with two or three inches up the bowel. It occa- y occurs higher up and beyond the reach of the finger, in the rectum, and occasion- ver down, nearer the anus or involving it. It is remarkably insidious in its origin certain in its progress, giving rise at first only to such symptoms as are usually put o constipation, for this symptom is the most prominent feature, while the occasional d bearing down or straining are looked upon as the result of the constipation. In al way it is only when some blood or sero-purulent fluid has passed, with or with- otion, that surgical aid is sought, and it is under such circumstances that the sur- scovers, on making a local examination, that such a serious disease exists.

cancerous ulcer can rarely be overlooked, and occurs as an indurated, nodular, ar mass. In its early stage it has a smooth surface, in a later ulceration, the dis- , which is generally very offensive, being made up of broken-up tissue, blood, and s. It involves, as a rule, the whole circumference of the bowel, at others only a It is always associated with some narrowing of the canal, which this will go on to ts complete occlusion. In September, 1871, I attended with Mr. Turner, of Ber- y, a girl, æt. 18, who had had insuperable constipation for seven weeks. I opened on in the *right* loin with great relief, and she was up and about in six weeks. She n months after the operation (June, 1872), with a rectum *completely occluded* from ous disease, and with secondary tubercles in the pelvic peritoneum. The disease amined at the Pathological Society by the Committee on Morbid Growths, and ported on by Dr. Hilton Fagge and Dr. Goodhart. They found it to be of a can- nature confined to the peritoneum and ovary, and only leading to stricture of the by a secondary process of contraction. The stricture had an ulcerated surface, but cous membrane did not show any cancerous elements ('Trans. Path. Soc.,' 1875). mptoms, indeed, are those of stricture.

TREATMENT.—Palliative treatment can alone be thought of, such as the mai and improvement of the general health by diet and tonics; the removal of all lo of irritation by the use of laxatives to render the motions more liquid and con more easy for evacuation; and the relief of pain by the use of enemata of st opium or by morphia suppositories.

In the very early stage of the affection before ulceration has taken place, t bougies may be justifiable and useful, but when ulceration exists they are inju dangerous. When the obstruction becomes a symptom of importance, surgical will have to be thought of; but this will be considered under the heading of st the bowel.

Complications of ulceration.—All cases of ulceration of the rectum t to cause stricture; the cancerous cases to a certainty must, the syphilitic ofte the simple may when extensive. The two latter cause a *cicatricial* stricture from the contraction of the cicatricial tissue in the mucous and submucous tissu producing a stricture by simple increment. They may also all be complicated seated abscesses and fistula, and with hemorrhoids. The surgeon should theref be careful when treating these affections to examine the rectum minutely, as it common to meet with cases that have been subjected to useless operations for fistula, when these affections were the results of a far more serious disease, suc ture or ulceration of the rectum.

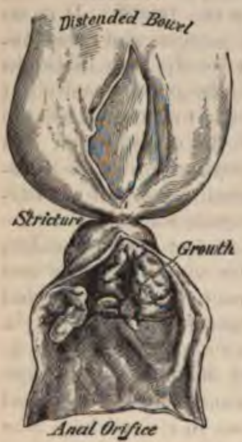
Again, any of these forms of ulceration may extend into the bladder or t have had five examples of such cases of vesico-intestinal fistula under my care and one in a female, in all of which the agonies of a foreign body in the bla added to those produced by the ulceration, and in the four male cases complete afforded by colotomy. In three of these the ulceration seemed to be of the si In another the existence of rectal ulceration was first revealed by a sudden ru through the rectum after an attack of retention.

I have seen many cases of recto-vaginal fistula as a consequence of syphiliti cerous disease.

STRICTURE OF THE RECTUM.

In the majority of cases this is caused by cancerous disease, in many it is t an inflammatory process, simple or syphilitic, from the cicatrization of deep extensive ulceration; in others, it is due to the contraction of inflammato poured out external to the bowel in the submucous tissue; in exceptional insta arise from contraction of the parts external to the bow vic cellulitis, and Curling quotes a case where it was result of an injury.

FIG. 297.



Stricture of rectum.
325^{80}, Guy's Hosp. Mus.

In all these conditions, the calibre of the intestine or rapidly encroached upon, till at last complete obstr place. The stricture may appear after death as an *a* traction of the bowel with adventitious material in the tissue and hypertrophy of the muscular coat, looking so-called scirrhous pylorus; or as a thickened, ulcerate mass of cancerous material infiltrating all the tissues o although rarely extending beyond two or three inche The bowel above the stricture will always be dilate even to rupturing, ulceration of the colon being a ve consequence of the dilatation. Below the stricture the be found pedunculated, fleshy, or cancerous grow points are well seen in Fig. 297.

It has been already pointed out that fistula, ischio-cal, or vaginal, abscesses and hemorrhoids, are comr paniments of stricture.

The disease, taken as a whole, is twice as commo as in men, and I found from my own notes that th of forty-eight consecutive cases were of the forme syphilitic stricture is more common in the female, and cancerous in the male.

Curling, in quoting 67 cases of cancer, gives 44 in males; and in my 48 ca found in subjects under thirty, 15 of these being women, and mostly, if not all 22 were in subjects over forty, half being men, the majority of these bei cancerous.

The approach of the disease is very insidious, whatever may be its origin or nature, and the symptoms are generally such as have been given under the heading of cancerous ulceration of the bowel.

Constipation is the one early symptom, and it is not till some ulceration has commenced either at the stricture or above it, that others appear. Of these the most common are *diarrhœa*, with lumpy stools, containing blood, pus, or mucus; ***straining*** at stool, and a *sensation of burning* in the part afterwards; at last a complete stoppage, abdominal distension and dyspeptic symptoms.

An examination with the finger carefully introduced into the rectum will, as a rule, at once reveal the true nature of the case, for about two inches up the bowel the narrowing will usually be felt with or without ulceration or the infiltration of the part with new tissue; sometimes the stricture is beyond the reach of the finger, and then probably by pressure upon the abdomen above the pelvis with the free hand, or by the introduction of the hand into the rectum, the disease may be felt.

When the stricture is *annular* it is probably cicatricial or fibrous, possibly cancerous.

When *epithelial* or positively cancerous, it will be infiltrated with a nodular, irregular mass of new tissue which may be breaking down and ulcerating, and occasionally the mass can be felt externally at the brim of the pelvis over the left iliac fossa.

When *syphilitic*, the ulceration will probably extend upwards from the anus, and such anal integumental outgrowths as have been already mentioned will exist.

In ordinary cases of cancerous stricture there is an inch of healthy rectum between the stricture and the anus, though in exceptional instances and where disease is extensive the anus is involved.

In advanced cases, the anus will appear patulous, and, on separating the buttocks, a red, brick-dust colored, feculent discharge may run out; wind will also pass without effort.

To the flat tape-like, or figured feces which some authors regard as being characteristic of this disease, I concur with Curling, in not ascribing much importance, since such a condition of motion is not uncommon even in a state of health, when the bowels are irritable; besides many other conditions of the pelvic parts may give rise to the same thing. When a patient never passes a well-formed motion, large or small, the case looks suspicious; and when, on the other hand, a large well-formed stool is occasionally seen, the probabilities of a stricture existing are very slight.

The examination with a tube, of a diseased rectum, flexible or otherwise, with or without injection, requires the greatest care and gentleness, as the gut is easily perforated or ruptured; moreover, the surgeon may be misled to suspect obstruction where none exists, by the end of the instrument striking against the sacrum, or being caught in a fold of mucous membrane.

It must also be remembered, in examining a rectum for a supposed stricture, that its calibre may be more or less completely encroached upon by pelvic tumors, uterine, ovarian, prostatic, hydatid, or bony. Some few years ago I had a case with Dr. De'Ath, of Buckingham, in which an hydatid tumor caused complete obstruction to the rectum as well as to the bladder, and although the latter organ was emptied on the evacuation of the hydatid contents, the patient died unrelieved from an enormous over-distended and ruptured colon ('Trans. Path. Society,' 1866). In April, 1870, I saw, with Mr. Phillips, of Leinster Square, a most interesting case of complete obstruction of the bowels in a lady, æt. 46, caused by the presence of a large, loose, cancerous growth hanging into the pelvis from the peritoneum, covering in the promontory of the sacrum. The tumor had been regarded by an eminent physician-accoucheur as uterine. Colotomy was performed with great relief, but death took place on the third day from collapse caused by a sudden rupture of the tumor and escape of its softened contents into the peritoneal cavity. In March, 1875, I also opened the descending colon of a boy, æt. 18, for complete obstruction of the rectum from a cancerous tumor that filled the pelvis and the abdomen as high as the umbilicus. The boy survived the operation two months, dying from other causes than obstruction.

TREATMENT.—It is so rare for a surgeon to be consulted about a stricture of the rectum till the ulcerative stage has set in, or almost complete obstruction has taken place, tha he has few opportunities of testing the value of dilatation of the stricture; since this practice is clearly useless, if not injurious, under these circumstances. In cicatricial or inflammatory strictures, however, it is the only form of practice upon which reliance can be placed.

Dilatation should be effected by mechanical means, but applied with caution, and forcible dilatation is inadmissible. Many instruments have been invented for the purpose, but the elastic-gum bougie is the favorite. I have, however, known so much harm to

follow its use that I have abandoned it, and prefer the sponge tent, by which
can be dilated in a painless and less dangerous way. When it does not produce
tation, a second and larger, may be passed in two days, but when irritation is
repetition of the operation should be postponed till it has subsided. By these
simple stricture may be checked in its progress, and even dilated, though ra
This practice may, however, prolong life for years. Mr. Curling gives a case
he believes he cured an annular stricture in a lady, æt. 24, by *incisions* and
I cannot, however, say that I have met with similar success.

M. Verneuil, in the 'Gazette Médicale de Paris,' for January, 1873, has ad
operation of "linear rectotomy" for the cure of stricture, meaning by this o
incision through the stricture and entire thickness of the bowel downwards a
the anus, including the sphincter, in the median dorsal line. He adduces t
which he performed this operation, and apparently with benefit. Dr. F. Le
York, has also advocated a like practice ('American Journ. of Med. Sciences,' J
adopting, however, an anterior as well as posterior incision in non-malignant

The dilatation, however, is only a means to an end, and that end is to secure
for the passage of the intestinal contents. Enemata are valuable aids to effe
pose, the daily washing out of the bowel with gruel and oil, or the daily dose
with manna, confection of senna with sulphur, or any other gentle laxative that
by experience has found to suit, giving great relief. Cod-liver oil in full dose
as a laxative as well as a tonic. Care, too, should be observed in the introdu
tube, for in a cancerous bowel perforation is very liable to occur, and even i
one this accident has taken place, the Guy's Museum containing a Prep.
which the colon was perforated by a bougie thirteen inches from the anus for
ary stricture, and a second (1877*), in which an O'Beirne's tube perforated
five inches from the anus in an attempt to pass it up the healthy bowel to give
case of obstruction after the reduction of a hernia.

How far it is safe to allow a patient to pass a bougie for himself or herself
question. I am disposed to think it is unwise to allow it when the bougie is
seen great irritation and consequently harm follow the practice, and in several
seated suppuration. Curling has given a case where the patient caused his
by perforating the bowel half an inch in extent above the stricture. I have
been in the habit of instructing my patients to use tallow candles as bougies,
been satisfied with the practice.

There comes a time, however, when this treatment by dilatation ceases to
or is associated with so much distress as to forbid its use; as when the stri
closed as to render it useless; or so ulcerated as to render it unwise to adopt
Under these circumstances the question of excision of this disease or the
otomy may be considered. The former operation will be discussed later on.
gives comfort to a degree that sometimes astonishes and always gratifies: it
and adds materially to its comfort, and little more than this can be said of
tions; moreover it is not found to be practically associated with such
surgeons of old have theoretically attributed to it. But it should not be
powers of life have become so exhausted as to render poor the chances of
the operation; or, till the cæcum or large intestine has become so distended
damaged or inflamed. It should be undertaken as soon as it is clear that the
passed beyond the reach of local treatment and the general powers of the
ning to fail; or as soon as the local distress finds no relief from palliative
a downward course is evidently approaching. The difficulties of colotomy
nor are its dangers numerous; when unsuccessful, it has been often made
its performance, from the want of power in the patient, or from the secondary
disease on the abdominal viscera. When most successful it gives immediate
of the symptoms, and makes life worth retaining. When least so, it
renders endurable what remains of life. The operation is now established
so to surgical art, although it must be admitted, that in the general way
postponed until too late a period to demonstrate its full value.

Excision of the Lower End of the Rectum.

This operation has but recently received attention in this country,
abroad by Lisfranc and others fifty years ago. It has, however, been
rich and other German surgeons, and by Dr. Levis, of Pennsylvania.

as been advocated as a means of cure for cancerous and other strictures of the a, and from Mr. R. Cripps's Jacksonian Prize Essay (1877) it seems to have been sful; since he records that out of 44 cases which he collected, only 9 died, or 1 in at in 14, recurrence took place in from four months to three years; that in 8, there o recurrence when the cases were last reported at the following periods: One year, 2, 4, 4, 6, and many years respectively after operation; and in 3 the patients were ome months afterwards.

likewise records, that in 23 cases, defecation was subsequently normal; in 6, that could be retained when not too fluid, and in 7, that there was incontinence. With facts it is clear that the operation for the removal of cancerous or other disease of ectum by excision is a justifiable and possibly a beneficial measure, and that it should ndertaken when the disease is local and can be so defined and isolated as to come n the reach of the surgeon's skill.

is clearly inapplicable when the disease has extended high up and the parts around rectum are infiltrated with cancerous disease. I have had no personal experience ot measures, never having attempted to remove more than anal growths.

would seem that about 2½ to 3 inches of rectum may be removed with safety, and when the bladder is fairly distended and traction is made upon the rectum, the peri-al pouch is less likely to be drawn down with it than when the bladder is empty. I satisfied myself upon these points by experiments upon the cadaver. After a metallic e has been introduced into the bladder to serve as a guide to the position of and to y the urethra, an incision is to be made from the base of the scrotum to the coccyx, cling both sides of the anal aperture. The hand of the operator may then be intro-d behind the bowel into the hollow of the sacrum, in order to tear the rectum loose its posterior attachments. By means of the finger and a pair of serrated scissors, the sions all around the rectum where, on account of the disease, it may be firmly attached prostate gland and neck of the bladder, should be broken up. The cancerous gut d next be carefully dissected from these parts, exposing to view the prostate and the part of the bladder, and, while this is being done, the vessels should be carefully ured or torsed as soon as divided and double sutures passed through the skin into the m, above the proposed line of excision. These should not, however, be fastened, but n position to give perfect control of the parts. When the rectum, including the can-us portion, has been thus carefully and thoroughly isolated, the gut ought to be drawn bly down by seizing the tumor, and the scissors employed to cut through the walls of bowel; a section of the rectum three inches in length can then be made, the sutures ted, and the gut securely stitched to the surrounding integuments.

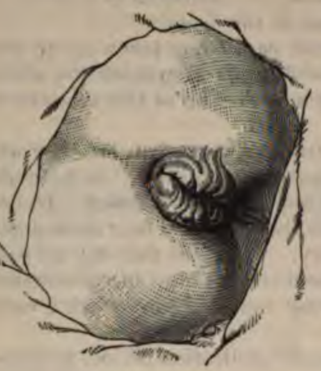
Atony of the Colon and Dilatation of the Rectum.

hese conditions are not unfrequently met with in practice. In old people, the colon, ant of power, often becomes enormously distended with feculent matter from gradual mulation, and this condition frequently causes death. In some cases, it gives rise to dea of stricture of the rectum, and every surgeon must have been called to cases in h impacted feces in the rectum and colon, associated with the discharge of small, offensive motions mixed with mucus and sometimes blood, has misled the attendant. e years ago, I was asked to see a lady over seventy, who had been bed-ridden for six ths, and was supposed to be dying from constipation and stricture of the rectum, ing but small lumpy and loose motions having passed. No disease whatever existed nd the impacted rectum and distended colon from atony of the bowel from old age. masses were mechanically removed by means of the lithotomy scoop and enemata of &c., and she lived four years, simply to die of old age.

this form of constipation, the value of nux vomica is well seen, a pill of half a grain e extract with half a grain of belladonna, twice a week or oftener, giving tone to the stine, and acting as a purge.

women specially, who have been in the habit of neglecting their bowels and allowing rectum to be a closed receptacle for feculent matter, the cavity not only becomes much nded, but seems to lose the power of contracting and expelling its contents. I had, years ago, at Guy's, a case illustrating these points. The rectum, on examination, ng like a loose bag, large enough to admit a fist was always full, having evidently lost ower of expulsion. The woman in young life had neglected herself, and in middle age d not overcome the effects of such neglect. By daily enemata of cold water to wash the bowel, and the subsequent injection of an astringent liquid, such as the decoction

FIG. 294.



Prolapsus recti.

prepuce; worms, constipation, dysentery, a polypus, or any rectal irritation may likewise induce it, as may a cough in very feeble subjects where the sphincter has lost its tone. One of the worst cases I have ever seen in an adult was due to the existence of a villous polypus high up the rectum, the straining accompanying the affection and the hemorrhage being very severe, but a rapid recovery ensued on the removal of the growth. In another case, that of a lady, where the bowel had come down for sixteen years accompanied with daily hemorrhage, and in which walking was rendered impossible from the extent of prolapse (about six inches of bowel) the removal of the mucous membrane in three portions by clamp and cautery rapidly effected a cure.

To ascertain the true cause of the affection, consequently, is the first aim of the surgeon, the treatment being then comparatively simple. On its removal the prolapse rapidly disappears.

TREATMENT.—Whenever the bowel comes down it should be returned, which can usually be readily effected by placing the patient in the recumbent posture and pressing with oiled fingers flat upon the part. In children, the utmost gentleness should be employed, for with pain, resistance is produced, and with it increased difficulty in reduction. Under all circumstances the patient should be kept in the recumbent posture. The bowels should in children be relieved lying down, and in adults, the horizontal posture ought always be assumed after natural relief. Brodie advised nocturnal relief of the bowels to be encouraged with this object. When the parts have been down for some time, the greatest trouble is often experienced in their reduction, indeed, sometimes it is impossible; although, with the patient under chloroform, success may attend the gentlest efforts when forcible attempts had previously failed. When the bowel had been reduced, a good pad, fastened on with a T bandage will keep it in place, or the nates may be fastened together with some good bands of strapping. When the bowel is inflamed or ulcerated, conditions that soon occur in chronic cases when the patient goes about, some slight scarification may be called for; but the application of cold in the form of ice is probably the best treatment. In some obstinate cases in children, the free application of the nitrate of silver in stick to the whole mucous surface, previously wiped with lint and subsequently mopped, is often followed by its reduction and retention. I have never seen this practice do harm; and one application has cured the disease. The injection of three or four ounces of water made astringent with tannic acid, in the proportion of three grains to the ounce; or, with tincture of iron, ten drops to the ounce; or of the infusion of krameria, or decoction of oak bark, with or without alum, after the bowels have been relieved, is a valuable adjunct; in adults the tannic acid suppository twice a day is useful, as also the application of the tannic acid glycerine before its reduction. A mixture of the solution of perchloride of iron with two of glycerine is likewise a good application. Costiveness should never be allowed, enemata being used to keep the bowels empty, or the mildest laxatives, as rhubarb, castor oil, or some natural saline waters as the Pullna, or Friedrichshall. To give the bowel tone, tonics, as a rule, are required, nux vomica being probably the best, either alone or in combination with iron. I have never employed this drug in children, though some surgeons speak highly of it, as the simpler tonics usually suffice. In children, as an alterative, rhubarb, soda, and calumba mixture is to be recommended. In more severe cases of prolapse, the application of nitric acid in vertical stripes is very valuable, or, what is better, the galvanic cautery similarly applied. In bad cases, it may be necessary to remove three or four vertical folds of mucous membrane with the clamp and cautery, as for piles. Copeland suggested the practice, although he removed the mucous membrane by means of the ligature; Brodie improved upon it by adopting nitric acid; and modern surgeons have still further simplified the treatment by introducing the clamp and cautery, galvanic or actual. Few operations in surgery are more successful than this, and although in children it is probably never acquired, yet in adults it should never be rejected except for the same causes as operations for hemorrhoids. In very extreme cases of prolapse, the linear cauterization of the prolapsed bowel may be advantageously applied.

The treatment of such a case would be precisely similar to that laid down in the last section for piles.

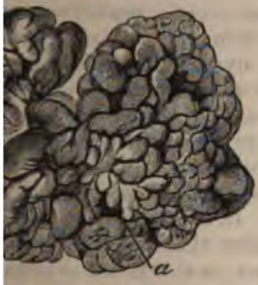
Polypus of the Rectum.

t so rare a disease as authors would lead us to believe. In the adult it proba-
affection, but in the child it is *the principal cause of hemorrhage from the*
om this fact, cases of polypus have been doubtless put down as those of piles.
hs are generally found in children under ten years of age. In hospital prac-
mostly seen in the out-patient department. They appear to be more com-
than in female subjects, since out of eighteen cases I have analyzed from my
urteen were males, thirteen were in children under ten, and five in adults.
in size from that of a pea to a large cherry, and grow from the submucous
covered by the mucous membrane. When far beyond the reach of the
d small, they probably do not cause any inconvenience, though when large,
e rise to straining of the bowel, prolapsus recti, and even intussusception.
orst examples of prolapsus recti I have ever been called upon to treat, was
resence of a fibrous polypus situated some inches up the bowel in a man 50
, who had suffered from it for twenty years. He was cured by the removal
h. Mr. Pollock ('Holmes's Syst.,' vol. iv, ed. 2) has given a case in which
on took place, and in another I have to relate the same result ensued. As
e sphincter local irritation and hemorrhage are produced, the growth appear-
the anus as a pink or red cherry. Blood sometimes flows from the anus only
ation, at other times quite independently of it. When the polypus is low
is usually with the blood a free discharge of mucus.

a child is brought with these symptoms, a local examination should be made,
is efficiently the surgeon should sweep his finger completely round the walls
, having passed it well into the rectum. By doing this, the polypus will be
its attachment and its pedicle made tense. Sometimes several polypi exist
have on one occasion removed three. They are made up of fibro-cellular
more or less fibrous according to the age of the patient; but in the adult,
lement predominates.

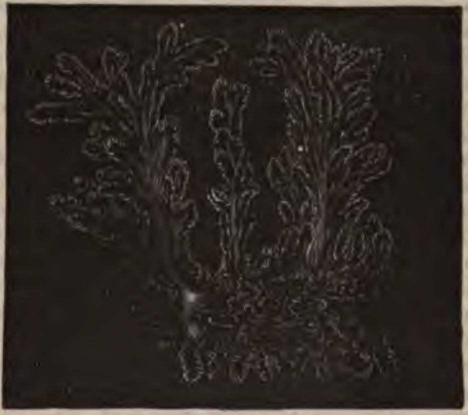
polypus has been discovered, its removal is the only correct practice. In
en I detect them with the finger, I generally manage to hook them down,
so they often break off. I have never seen any bleeding follow this measure.
ccasions when I have brought the growth external to the sphincter, the action
e has broken it away, and in this manner, many cases of polypi are naturally

Fig. 295.



ous polypus of rectum.

Fig. 296.



Dr. Moxon's Report on Villous Growths, with drawings.
Vertical section of polypus through the line *a*, Fig. 295, showing vascular simple and compound villi, covered with a columnar epithelium; large vessels in the base on which the villi rest; and sections of the follicles of Lieberkühn. This section represents half the thickness of a lobule of the polypus seen by 1¼-inch power.

en they do not break off, a
be applied to the pedicle,
to cut off the growth after
on beyond the knot. In
ligature should always be

emoval of the disease the
sappear, but when they con-
nd polypus will generally be

growths are occasionally
the rectum as in other parts of the large intestine, and when low down they
violent straining and hemorrhage. This straining may, indeed, give rise to

an intussusception of the bowel, or to prolapsus recti. This was well exemplified in the case of a woman, æt. 43, whom I had under my care in June, 1867. She had suffered from prolapsus recti after every motion for twenty years, with more or less bleeding, the straining at times being most distressing. When I saw her, the bowel was down for about nine inches; blood was then passing, and the pain was great. I made a careful examination, but failed to find anything. I reduced the prolapsus, and prescribed rest. On my second visit, with the bowel only down a very little, I examined her again, and with my finger could just touch a new growth. With a pair of long forceps I took hold of it and brought it down, finding a splendid specimen of the villous polypus. I put a ligature round its base at once, and cut off the growth. No single unfavorable symptom had to be recorded subsequently; all her former troubles at once disappearing and a complete recovery ensued. In June, 1870, this woman was still well. The growth is illustrated in Fig. 295, with the microscopical appearances (Fig. 296), and Dr. Moxon's report.

Condylomata are also very common about the anus, and are mostly, but not always, syphilitic, the irritation of dirt being probably sufficient to produce them. In children they seem to come from the irritation of worms.

Cleanliness, the application of nitrate of silver, and the dusting of their surfaces with calomel or oxide of zinc, generally produce a rapid cure. *Vegetations* due to the irritation of acrid discharges, such as *gonorrhœa* or *syphilis*, require to be excised.

Warty growths are also met with about the anus as on other cutaneous surfaces. Sometimes they grow to a great extent and then require excision. I have removed a mass the size of a fist.

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ULCERATION OF THE ANUS AND RECTUM.

The painful ulcer of the anus or anal orifice of the rectum has been already noticed, and it remains for us to consider briefly such other forms of ulceration of the rectum as are met with in practice. They may be described as *simple*, *syphilitic*, and *cancerous*. *Simple* ulceration is by no means unfrequent, and, when not involving the anus, it gives rise to symptoms which are usually looked upon as dysenteric. The passage of lumpy feces with blood and muco-purulent discharge are the chief symptoms. The rapid passage of the intestinal contents through the sigmoid flexure and rectum gives rise to a slight griping pain, but beyond this, there are few general symptoms. On examining a rectum under these circumstances, a single ulcer will probably be found, but occasionally others. It may be somewhat indurated at its edges, though its base is not so as a whole. It is often circular, and at times surrounding half the rectum. In the case of a boy, æt. 16, under my treatment, the surface of the ulcer was so nodular that I should have suspected its cancerous nature had I met with it in an adult, but in this instance it had existed for many months, and the granulations had assumed a polypoid nature. It ended in a recovery. These simple ulcers are also likely to perforate the bladder and to induce recto-vesical fistula. I have had five such cases, and in four, colotomy was performed with success, the operation taking away the chief source of distress, viz., the passage of feces with the urine—prolonging life, and apparently allowing the ulcers to heal. (*Vide* paper by author, 'Clinical Soc.,' 1872.)

These cases can be *treated* by general means, such as a careful regulation of the diet, alkaline medicines with tonics, the administration of laxatives such as the mistura olei to cause and maintain a soft condition of the feces, and the daily administration of a small two-ounce enema of starch and opium, or simple oil. The recumbent position should be maintained as much as possible.

Under these circumstances a good recovery generally takes place.

When these ulcers involve the anus, they give rise to the same painful symptoms as the painful ulcer of the anus, and must be treated in a similar way, viz., by division of the superficial fibres of the sphincter.

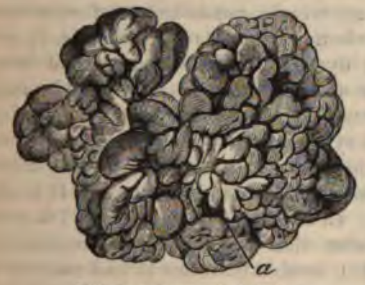
POLYPUS OF THE RECTUM.

This is not so rare a disease as authors would lead us to believe. In the adult it probably is a rare affection, but in the child it is *the principal cause of hemorrhage from the bowel*, and from this fact, cases of polypus have been doubtless put down as those of piles. These growths are generally found in children under ten years of age. In hospital practice they are mostly seen in the out-patient department. They appear to be more common in male than in female subjects, since out of eighteen cases I have analyzed from my note-book, fourteen were males, thirteen were in children under ten, and five in adults. These vary in size from that of a pea to a large cherry, and grow from the submucous tissue, being covered by the mucous membrane. When far beyond the reach of the sphincter, and small, they probably do not cause any inconvenience, though when large, they may give rise to straining of the bowel, prolapsus recti, and even intussusception. One of the worst examples of prolapsus recti I have ever been called upon to treat, was due to the presence of a fibrous polypus situated some inches up the bowel in a man 50 years of age, who had suffered from it for twenty years. He was cured by the removal of the growth. Mr. Pollock ('Holmes's Syst.,' vol. iv, ed. 2) has given a case in which intussusception took place, and in another I have to relate the same result ensued. As they near the sphincter local irritation and hemorrhage are produced, the growth appearing often at the anus as a pink or red cherry. Blood sometimes flows from the anus only during defecation, at other times quite independently of it. When the polypus is low down, there is usually with the blood a free discharge of mucus.

Whenever a child is brought with these symptoms, a local examination should be made, and to do this efficiently the surgeon should sweep his finger completely round the walls of the bowel, having passed it well into the rectum. By doing this, the polypus will be dragged from its attachment and its pedicle made tense. Sometimes several polypi exist together. I have on one occasion removed three. They are made up of fibro-cellular tissue, being more or less fibrous according to the age of the patient; but in the adult, the fibrous element predominates.

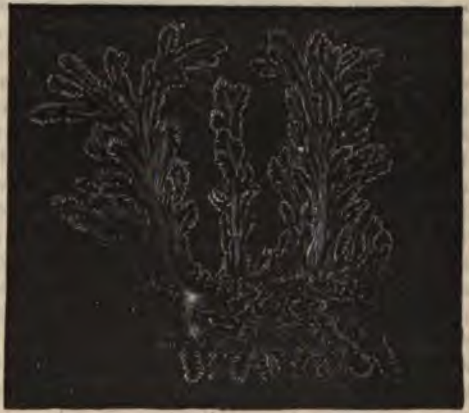
When a polypus has been discovered, its removal is the only correct practice. In children, when I detect them with the finger, I generally manage to hook them down, and in doing so they often break off. I have never seen any bleeding follow this measure. On several occasions when I have brought the growth external to the sphincter, the action of the muscle has broken it away, and in this manner, many cases of polypi are naturally cured. When they do not break off, a ligature may be applied to the pedicle, but its well to cut off the growth after its application beyond the knot. In adults, the ligature should always be employed.

FIG. 295.



Villous polypus of rectum.

FIG. 296.



Dr. Moxon's Report on Villous Growths, with drawings.

Vertical section of polypus through the line *a*, Fig. 295, showing vascular simple and compound villi, covered with a columnar epithelium; large vessels in the base on which the villi rest; and sections of the follicles of Lieberkühn. This section represents half the thickness of a lobule of the polypus seen by 1½-inch power.

On the removal of the disease the symptoms disappear, but when they continue, a second polypus will generally be found.

Villous growths are occasionally met with in the rectum as in other parts of the large intestine, and when low down they give rise to violent straining and hemorrhage. This straining may, indeed, give rise to an intussusception of the bowel, or to prolapsus recti. This was well exemplified in the case of a woman, æt. 43, whom I had under my care in June, 1867. She had suffered from prolapsus recti after every motion for twenty years, with more or less bleeding, the straining at times being most distressing. When I saw her, the bowel was down for about nine inches; blood was then passing, and the pain was great. I made a careful examination, but failed to find anything. I reduced the prolapsus, and prescribed rest. On my second visit, with the bowel only down a very little, I examined her again, and with my finger could just touch a new growth. With a pair of long forceps I took hold of it and brought it down, finding a splendid specimen of the villous polypus. I put a ligature round its base at once, and cut off the growth. No single unfavorable symptom had to be recorded subsequently; all her former troubles at once disappearing and a complete recovery ensued. In June, 1870, this woman was still well. The growth is illustrated in Fig. 295, with the microscopical appearances (Fig. 296), and Dr. Moxon's report.

Condylomata are also very common about the anus, and are mostly, but not always, syphilitic, the irritation of dirt being probably sufficient to produce them. In children they seem to come from the irritation of worms.

Cleanliness, the application of nitrate of silver, and the dusting of their surfaces with calomel or oxide of zinc, generally produce a rapid cure. *Vegetations* due to the irritation of acrid discharges, such as *gonorrhœa* or *syphilis*, require to be excised.

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Under these circumstances a good recovery generally takes place.

When these ulcers involve the anus, they give rise to the same painful symptoms as the painful ulcer of the anus, and must be treated in a similar way, viz., by division of the superficial fibres of the sphincter.

Syphilitic disease of the rectum is a more common affection and is met with in both sexes though more frequently in women than in men, the disease apparently creeping from the vagina to the rectum. Occasionally it is due, doubtless, to direct introduction of the poison. It appears as a more or less extensive ulceration of the lower two inches of the rectum; and, as a rule, involving the anus, as well as passing higher up the rectum. It is a disease of the mucous and submucous tissues, and is indicated in its early stage by a spongy induration of these tissues, and later by ulceration and the discharge of a highly irritating sero-purulent or sanguineous discharge and by a patulous anus. The anus itself may also be the seat of the lateral, flattened, fleshy, cutaneous outgrowth so common in syphilis, or it may be ulcerated. It is generally a disease of young adult life, and associated with some syphilitic history. There is almost always some pain in the act of defecation, some looseness of the bowels, and discharge of blood, pus, or mucus. Anal or vaginal fistulæ sometimes complicate the case. In neglected cases where cicatrization has gone on with spreading ulceration, there may be constipation and some stricture; indeed, as a cause of stricture of the rectum, this syphilitic disease is by no means unusual.

TREATMENT.—Recognizing its syphilitic origin, large doses of the iodide of potassium ought to be given, five grains three times a day, gradually increased to ten or twenty, in some bitter infusion or bark; but when tonics are indicated, they may be given in combination. The bowels should be kept slightly loose by the daily dose of olive oil or castor oil, so regulated as not to purge, and the daily employment of an enema of starch or gruel, with or without oil, to keep the parts clean and free from the irritation of feces.

The recumbent posture should likewise be observed, as well as simple, nutritious, but not bulky, food taken.

Locally, absolute cleanliness is essential. Where contraction exists or is taking place, the daily introduction of a bougie anointed with some mild mercurial ointment, such as the unguentum metallorum, may be used; but for the patient, the daily introduction of a candle similarly anointed is preferable, candles being made of all sizes. Nothing like mechanical dilatation should be thought of, as it is dangerous in the extreme. By these means a cure may be effected, though such can only be complete after the treatment of months. In very neglected or severe cases, a cure is almost hopeless without colotomy. I have had some striking examples under my care illustrating well the advantages of this operation. The recognition of the disease as syphilitic is the main point to be made out.

Foreign authors describe *chancroid* disease of the rectum as venereal and not syphilitic; but in this country it is hardly recognized. Such may, however, be found amongst those described as cases of simple ulceration.

Cancerous ulceration of the rectum, usually **epithelial,** sometimes villous, rarely carcinomatous, is generally met with two or three inches up the bowel. It occasionally occurs higher up and beyond the reach of the finger, in the rectum, and occasionally lower down, nearer the anus or involving it. It is remarkably insidious in its origin and uncertain in its progress, giving rise at first only to such symptoms as are usually put down to constipation, for this symptom is the most prominent feature, while the occasional pain and bearing down or straining are looked upon as the result of the constipation. In a general way it is only when some blood or sero-purulent fluid has passed, with or without a motion, that surgical aid is sought, and it is under such circumstances that the surgeon discovers, on making a local examination, that such a serious disease exists.

The cancerous ulcer can rarely be overlooked, and occurs as an indurated, nodular, irregular mass. In its early stage it has a smooth surface, in a later ulceration, the discharge, which is generally very offensive, being made up of broken-up tissue, blood, and thin pus. It involves, as a rule, the whole circumference of the bowel, at others only a part. It is always associated with some narrowing of the canal, which this will go on to cause its complete occlusion. In September, 1871, I attended with Mr. Turner, of Bermondsey, a girl, æt. 18, who had had insuperable constipation for seven weeks. I opened her colon in the *right* loin with great relief, and she was up and about in six weeks. She died ten months after the operation (June, 1872), with a rectum *completely occluded* from cancerous disease, and with secondary tubercles in the pelvic peritoneum. The disease was examined at the Pathological Society by the Committee on Morbid Growths, and was reported on by Dr. Hilton Fagge and Dr. Goodhart. They found it to be of a cancerous nature confined to the peritoneum and ovary, and only leading to stricture of the bowel by a secondary process of contraction. The stricture had an ulcerated surface, but the mucous membrane did not show any cancerous elements ('Trans. Path. Soc.,' 1875). The symptoms, indeed, are those of stricture.

Treatment.—Palliative treatment can alone be thought of, such as the maintenance and improvement of the general health by diet and tonics; the removal of all local causes of irritation by the use of laxatives to render the motions more liquid and consequently more easy for evacuation; and the relief of pain by the use of enemata of starch and opium or by morphia suppositories.

In the very early stage of the affection before ulceration has taken place, the use of bougies may be justifiable and useful, but when ulceration exists they are injurious and dangerous. When the obstruction becomes a symptom of importance, surgical treatment will have to be thought of; but this will be considered under the heading of stricture of the bowel.

Complications of ulceration.—All cases of ulceration of the rectum may go on to cause stricture; the cancerous cases to a certainty must, the syphilitic often do, and the simple may when extensive. The two latter cause a *cicatricial* stricture resulting from the contraction of the cicatricial tissue in the mucous and submucous tissue; the first producing a stricture by simple increment. They may also all be complicated with deep-seated abscesses and fistula, and with hemorrhoids. The surgeon should therefore always be careful when treating these affections to examine the rectum minutely, as it is only too common to meet with cases that have been subjected to useless operations for piles and fistula, when these affections were the results of a far more serious disease, such as stricture or ulceration of the rectum.

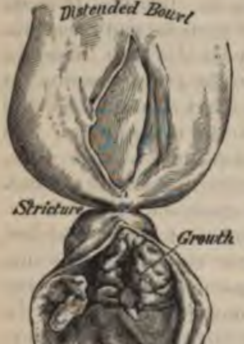
Again, any of these forms of ulceration may extend into the bladder or urethra. I have had five examples of such cases of vesico-intestinal fistula under my care in males, and one in a female, in all of which the agonies of a foreign body in the bladder were added to those produced by the ulceration, and in the four male cases complete relief was afforded by colotomy. In three of these the ulceration seemed to be of the simple kind. In another the existence of rectal ulceration was first revealed by a sudden rush of urine through the rectum after an attack of retention.

I have seen many cases of recto-vaginal fistula as a consequence of syphilitic and cancerous disease.

STRICTURE OF THE RECTUM.

In the majority of cases this is caused by cancerous disease, in many it is the result of an inflammatory process, simple or syphilitic, from the cicatrization of deep-seated and extensive ulceration; in others, it is due to the contraction of inflammatory material poured out external to the bowel in the submucous tissue; in exceptional instances, it may arise from contraction of the parts external to the bowel after pelvic cellulitis, and Curling quotes a case where it was the direct result of an injury.

Fig. 297.



Stricture of rectum.
325^{40}, Guy's Hosp. Mus.

In all these conditions, the calibre of the intestine is gradually or rapidly encroached upon, till at last complete obstruction takes place. The stricture may appear after death as an *annular* contraction of the bowel with adventitious material in the submucous tissue and hypertrophy of the muscular coat, looking very like a so-called scirrhous pylorus; or as a thickened, ulcerated, irregular mass of cancerous material infiltrating all the tissues of the bowel, although rarely extending beyond two or three inches in length. The bowel above the stricture will always be dilated, at times even to rupturing, ulceration of the colon being a very common consequence of the dilatation. Below the stricture there will often be found pedunculated, fleshy, or cancerous growths. These points are well seen in Fig. 297.

It has been already pointed out that fistula, ischio-rectal, vesical, or vaginal, abscesses and hemorrhoids, are common accompaniments of stricture.

The disease, taken as a whole, is twice as common in women as in men, and I found from my own notes that thirty-two out of forty-eight consecutive cases were of the former sex. But syphilitic stricture is more common in the female, and cancerous in the male.

Curling, in quoting 67 cases of cancer, gives 44 in males; and in my 48 cases 20 were found in subjects under thirty, 15 of these being women, and mostly, if not all, syphilitic; 22 were in subjects over forty, half being men, the majority of these being probably cancerous.

The approach of the disease is very insidious, whatever may be its origin or nature, and the symptoms are generally such as have been given under the heading of cancerous ulceration of the bowel.

Constipation is the one early symptom, and it is not till some ulceration has commenced either at the stricture or above it, that others appear. Of these the most common are *diarrhœa*, with lumpy stools, containing blood, pus, or mucus; *straining* at stool, and a *sensation of burning* in the part afterwards; at last a complete stoppage, abdominal distension and dyspeptic symptoms.

An examination with the finger carefully introduced into the rectum will, as a rule, at once reveal the true nature of the case, for about two inches up the bowel the narrowing will usually be felt with or without ulceration or the infiltration of the part with new tissue; sometimes the stricture is beyond the reach of the finger, and then probably by pressure upon the abdomen above the pelvis with the free hand, or by the introduction of the hand into the rectum, the disease may be felt.

When the stricture is *annular* it is probably cicatricial or fibrous, possibly cancerous.

When *epithelial* or positively cancerous, it will be infiltrated with a nodular, irregular mass of new tissue which may be breaking down and ulcerating, and occasionally the mass can be felt externally at the brim of the pelvis over the left iliac fossa.

When *syphilitic*, the ulceration will probably extend upwards from the anus, and such anal integumental outgrowths as have been already mentioned will exist.

In ordinary cases of cancerous stricture there is an inch of healthy rectum between the stricture and the anus, though in exceptional instances and where disease is extensive the anus is involved.

In advanced cases, the anus will appear patulous, and, on separating the buttocks, a red, brick-dust colored, feculent discharge may run out; wind will also pass without effort.

To the flat tape-like, or figured feces which some authors regard as being characteristic of this disease, I concur with Curling, in not ascribing much importance, since such a condition of motion is not uncommon even in a state of health, when the bowels are irritable; besides many other conditions of the pelvic parts may give rise to the same thing. When a patient never passes a well-formed motion, large or small, the case looks suspicious; and when, on the other hand, a large well-formed stool is occasionally seen, the probabilities of a stricture existing are very slight.

The examination with a tube, of a diseased rectum, flexible or otherwise, with or without injection, requires the greatest care and gentleness, as the gut is easily perforated or ruptured; moreover, the surgeon may be misled to suspect obstruction where none exists, by the end of the instrument striking against the sacrum, or being caught in a fold of mucous membrane.

It must also be remembered, in examining a rectum for a supposed stricture, that its calibre may be more or less completely encroached upon by pelvic tumors, uterine, ovarian, prostatic, hydatid, or bony. Some few years ago I had a case with Dr. De'Ath, of Buckingham, in which an hydatid tumor caused complete obstruction to the rectum as well as to the bladder, and although the latter organ was emptied on the evacuation of the hydatid contents, the patient died unrelieved from an enormous over-distended and ruptured colon ('Trans. Path. Society,' 1866). In April, 1870, I saw, with Mr. Phillips, of Leinster Square, a most interesting case of complete obstruction of the bowels in a lady, æt. 46, caused by the presence of a large, loose, cancerous growth hanging into the pelvis from the peritoneum, covering in the promontory of the sacrum. The tumor had been regarded by an eminent physician-accoucheur as uterine. Colotomy was performed with great relief, but death took place on the third day from collapse caused by a sudden rupture of the tumor and escape of its softened contents into the peritoneal cavity. In March, 1875, I also opened the descending colon of a boy, æt. 18, for complete obstruction of the rectum from a cancerous tumor that filled the pelvis and the abdomen as high as the umbilicus. The boy survived the operation two months, dying from other causes than obstruction.

TREATMENT.—It is so rare for a surgeon to be consulted about a stricture of the rectum till the ulcerative stage has set in, or almost complete obstruction has taken place, tha he has few opportunities of testing the value of dilatation of the stricture; since this practice is clearly useless, if not injurious, under these circumstances. In cicatricial or inflammatory strictures, however, it is the only form of practice upon which reliance can be placed.

Dilatation should be effected by mechanical means, but applied with caution, and forcible dilatation is inadmissible. Many instruments have been invented for the purpose, but the elastic-gum bougie is the favorite. I have, however, known so much harm to follow its use that I have abandoned it, and prefer the sponge tent, by which a stricture can be dilated in a painless and less dangerous way. When it does not produce any irritation, a second and larger, may be passed in two days, but when irritation is set up, the repetition of the operation should be postponed till it has subsided. By these means a simple stricture may be checked in its progress, and even dilated, though rarely cured. This practice may, however, prolong life for years. Mr. Curling gives a case in which he believes he cured an annular stricture in a lady, æt. 24, by *incisions* and dilatation. I cannot, however, say that I have met with similar success.

M. Verneuil, in the 'Gazette Médicale de Paris,' for January, 1873, has advocated the operation of "linear rectotomy" for the cure of stricture, meaning by this operation an incision through the stricture and entire thickness of the bowel downwards and through the anus, including the sphincter, in the median dorsal line. He adduces two cases in which he performed this operation, and apparently with benefit. Dr. F. Lente, of New York, has also advocated a like practice ('American Journ. of Med. Sciences,' July, 1873), adopting, however, an anterior as well as posterior incision in non-malignant strictures.

The dilatation, however, is only a means to an end, and that end is to secure an opening for the passage of the intestinal contents. Enemata are valuable aids to effect this purpose, the daily washing out of the bowel with gruel and oil, or the daily dose of mist. olei with manna, confection of senna with sulphur, or any other gentle laxative that the patient by experience has found to suit, giving great relief. Cod-liver oil in full doses often acts as a laxative as well as a tonic. Care, too, should be observed in the introduction of the tube, for in a cancerous bowel perforation is very liable to occur, and even in a healthy one this accident has taken place, the Guy's Museum containing a Prep. (1877^{60}), in which the colon was perforated by a bougie thirteen inches from the anus for an imaginary stricture, and a second (1877^{80}), in which an O'Beirne's tube perforated the rectum five inches from the anus in an attempt to pass it up the healthy bowel to give relief in a case of obstruction after the reduction of a hernia.

How far it is safe to allow a patient to pass a bougie for himself or herself is another question. I am disposed to think it is unwise to allow it when the bougie is solid, having seen great irritation and consequently harm follow the practice, and in several cases deep-seated suppuration. Curling has given a case where the patient caused his own death by perforating the bowel half an inch in extent above the stricture. I have consequently been in the habit of instructing my patients to use tallow candles as bougies, and have been satisfied with the practice.

There comes a time, however, when this treatment by dilatation ceases to be beneficial or is associated with so much distress as to forbid its use; as when the stricture has so closed as to render it useless; or so ulcerated as to render it unwise to adopt the practice. Under these circumstances the question of *excision* of this disease or the operation of *Colotomy* may be considered. The former operation will be discussed later on. The latter gives comfort to a degree that sometimes astonishes and always gratifies: it prolongs life, and adds materially to its comfort, and little more than this can be said of most operations; moreover it is not found to be practically associated with such inconvenience as surgeons of old have theoretically attributed to it. But it should not be postponed till the powers of life have become so exhausted as to render poor the chances of recovery from the operation; or, till the cæcum or large intestine has become so distended as to be much damaged or inflamed. It should be undertaken as soon as it is clear that the disease has passed beyond the reach of local treatment and the general powers of the patient are *beginning* to fail; or as soon as the local distress finds no relief from palliative measures, and a downward course is evidently approaching. The difficulties of colotomy are not great, nor are its dangers numerous; when *unsuccessful*, it has been often made so by delay in its performance, from the want of power in the patient, or from the secondary effects of the disease on the abdominal viscera. When *most successful* it gives immediate relief to most of the symptoms, and makes life worth retaining. When *least* so, it lessens pain and renders endurable what remains of life. The operation is now established and creditably so to surgical art, although it must be admitted, that in the general way it is apt to be postponed until too late a period to demonstrate its full value.

Excision of the Lower End of the Rectum.

This operation has but recently received attention in this country, although practised abroad by Lisfranc and others fifty years ago. It has, however, been performed by Billroth and other German surgeons, and by Dr. Levis, of Pennsylvania.

It has been advocated as a means of cure for cancerous and other strictures of the tum, and from Mr. R. Cripps's Jacksonian Prize Essay (1877) it seems to have been cessful; since he records that out of 44 cases which he collected, only 9 died, or 1 in that in 14, recurrence took place in from four months to three years; that in 8, there as no recurrence when the cases were last reported at the following periods: One year, 2, 2, 4, 4, 6, and many years respectively after operation; and in 3 the patients were ell some months afterwards.

He likewise records, that in 23 cases, defecation was subsequently normal; in 6, that ces could be retained when not too fluid, and in 7, that there was incontinence. With hese facts it is clear that the operation for the removal of cancerous or other disease of the rectum by excision is a justifiable and possibly a beneficial measure, and that it should be undertaken when the disease is local and can be so defined and isolated as to come within the reach of the surgeon's skill.

It is clearly inapplicable when the disease has extended high up and the parts around the rectum are infiltrated with cancerous disease. I have had no personal experience ot the measures, never having attempted to remove more than anal growths.

It would seem that about 2½ to 3 inches of rectum may be removed with safety, and that when the bladder is fairly distended and traction is made upon the rectum, the peritoneal pouch is less likely to be drawn down with it than when the bladder is empty. I have satisfied myself upon these points by experiments upon the cadaver. After a metallic bougie has been introduced into the bladder to serve as a guide to the position of and to steady the urethra, an incision is to be made from the base of the scrotum to the coccyx, encircling both sides of the anal aperture. The hand of the operator may then be introduced behind the bowel into the hollow of the sacrum, in order to tear the rectum loose from its posterior attachments. By means of the finger and a pair of serrated scissors, the adhesions all around the rectum where, on account of the disease, it may be firmly attached to the prostate gland and neck of the bladder, should be broken up. The cancerous gut should next be carefully dissected from these parts, exposing to view the prostate and the lower part of the bladder, and, while this is being done, the vessels should be carefully ligatured or torsed as soon as divided and double sutures passed through the skin into the rectum, above the proposed line of excision. These should not, however, be fastened, but left in position to give perfect control of the parts. When the rectum, including the cancerous portion, has been thus carefully and thoroughly isolated, the gut ought to be drawn forcibly down by seizing the tumor, and the scissors employed to cut through the walls of the bowel; a section of the rectum three inches in length can then be made, the sutures knotted, and the gut securely stitched to the surrounding integuments.

ATONY OF THE COLON AND DILATATION OF THE RECTUM.

These conditions are not unfrequently met with in practice. In old people, the colon, for want of power, often becomes enormously distended with feculent matter from gradual accumulation, and this condition frequently causes death. In some cases, it gives rise to the idea of stricture of the rectum, and every surgeon must have been called to cases in which impacted feces in the rectum and colon, associated with the discharge of small, loose, offensive motions mixed with mucus and sometimes blood, has misled the attendant. Some years ago, I was asked to see a lady over seventy, who had been bed-ridden for six months, and was supposed to be dying from constipation and stricture of the rectum, nothing but small lumpy and loose motions having passed. No disease whatever existed beyond the impacted rectum and distended colon from atony of the bowel from old age. The masses were mechanically removed by means of the lithotomy scoop and enemata of oil, &c., and she lived four years, simply to die of old age.

In this form of constipation, the value of nux vomica is well seen, a pill of half a grain of the extract with half a grain of belladonna, twice a week or oftener, giving tone to the intestine, and acting as a purge.

In women specially, who have been in the habit of neglecting their bowels and allowing the rectum to be a closed receptacle for feculent matter, the cavity not only becomes much distended, but seems to lose the power of contracting and expelling its contents. I had, some years ago, at Guy's, a case illustrating these points. The rectum, on examination, feeling like a loose bag, large enough to admit a fist was always full, having evidently lost all power of expulsion. The woman in young life had neglected herself, and in middle age could not overcome the effects of such neglect. By daily enemata of cold water to wash out the bowel, and the subsequent injection of an astringent liquid, such as the decoction of bark and alum, with the daily use of a pill containing half a grain of extract of nux vomica mixed with gentian, a complete recovery took place.

The Administration of Food and Medicine by the Rectum.

Physiologists have long known that water, certain forms of food, and medicines are absorbed by the rectum, and physicians have acted upon this knowledge; though possibly the physiological fact has not been utilized so fully as it deserves.

It has, however, such an important bearing for good upon surgical practice, that it would be well to regard the rectum as a second stomach, and, in certain cases, to use the one for nutritive or medical purposes as a substitute or accessory for the other. I have for years acted upon this principle, and have every reason to be satisfied with the result. Indeed, in any case of disease or injury in which nutriment is essential, and the stomach refuses to receive or retain food, I have never hesitated to resort to the nutrient enema.

I do so also in cases of abdominal injury or disease, in which it is *inexpedient* to give the stomach or small intestines work to do. In aged patients after injury or operation, when, from shock, the stomach seems incapable of doing its duty, as well as in all cases of persistent vomiting, whether after the use of anæsthetics or otherwise, to give time for the stomach to regain its tone. The use of the nutrient enema for a few hours often tides over a slight, and for days, over a great difficulty, as without doubt it supplies food to the body almost as well as the usual meal, and does so under circumstances in which the latter cannot or ought not to be administered. In a case I had with Dr. Parsons Smith, of Addiscombe, life was entirely maintained for fifteen weeks by its use; and I could adduce others in which its beneficial influence is most marked. Dr. Flint, of New York, has published one case in which life was sustained for fifteen months by this method, and he adds, that during five years, the patient had depended almost entirely upon it. In cases of unconsciousness from anæsthetics or otherwise, this practice should be followed in preference to any other, as it seems more than probable that, under these circumstances, any fluid which it is attempted to pour into the mouth passes into the lungs rather than into the œsophagus, and consequently hastenes death.

Directions for use.

The bowels should be emptied by a simple enema before the nutrient one is introduced.

The nutrient enema should be used every four or six hours, and should not consist of more than six ounces.

The material should be tepid, and introduced *slowly*, as the rectum repudiates any sudden distension.

After its administration, a napkin should be pressed against the anus until the disposition to expel it has passed away.

When the expulsion tendency is great, opium may be added to the enema; indeed, under all circumstances, it is of advantage.

At times, the enema is retained better when introduced some six inches into the rectum than within the sphincters.

When injections are badly tolerated at first they may at times be well retained if they are persisted in.

The best materials for these enemata are—milk, eggs, meat juices with pancreas or pancreatic emulsion, and these may be employed at different times. It is a mistake to keep too long to one kind.

Milk and eggs, alternating with one of meat juice and pancreas, seems to be preferable.

As a meat emulsion, Kaufmann's mixture is excellent, composed of a pound of minced beef, a third of a pound of fresh pancreas, and half a pint of cold water. The whole allowed to macerate for three-quarters of an hour, gradually raised to the boiling point, and boiled for two minutes. The mixture will then have been reduced to the consistence of a thick soup.

When this mixture is not at hand, good beef-tea or mutton broth may be employed, to which Liebig's extract of meat may be added.

In making beef-tea or broth, long boiling does no good. A pound of finely-minced meat macerated in half a pint of cold water for three or four hours will give an excellent mixture; and, if the whole is well shaken for half an hour, nearly the same result is obtained.

Rectal medication in its way is as valuable as alimentation, more particularly when orphia, opium, or mercury is prescribed. The former drugs administered after an operation before the influence of the anæsthetics has passed off, doing more to calm the tient and give rest than any other method, more particularly in cases of abdominal rgery.

The latter employed twice a day acting on syphilitic patients in such a quiet and eneficial way as to lead me to look upon it as the best method of bringing any one under s influence.

SURGERY OF THE RESPIRATORY SYSTEM.

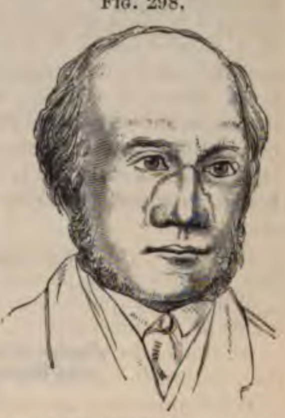
CHAPTER XVII.

SURGICAL AFFECTIONS OF THE NOSE.

Wounds.

Incised and lacerated wounds of the nose generally progress well on account of the freedom of its vascular supply. The edges of any wound should consequently be brought carefully together and fixed with sutures, even if the part be nearly separated from the body. For this purpose very fine silk ought to be used, and great care exercised in the accurate adjustment of the parts—a suture being passed through the cartilages when they have been divided. In the case illustrated in Fig. 298, where the nose was nearly cut off, the edges of the wound were adjusted, and a good recovery followed. This case occurred in the practice of my lamented late colleague, Mr. Poland.

Fig. 298.



Drawing illustrating the repair after an incised wound of the nose.

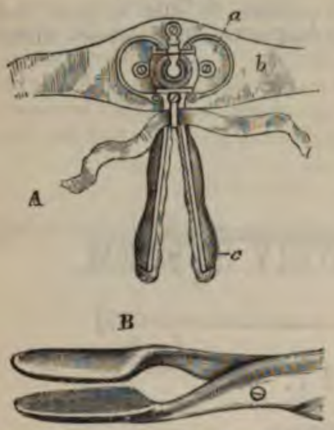
Fracture of the Nose.

This accident is not uncommon, and may be simple or compound. It may likewise be followed by little or great deformity, the amount depending much upon the care and skill with which the broken bones are readjusted. When little or no displacement exists, nothing else is required than the application of cold-water dressing, or perhaps ice, for the first few hours, as these bones rapidly re-unite. When displacement has taken place, the surgeon must restore the misplaced bones by external manipulation, aided by pressure applied from within the nasal cavity by means of the blades of the ordinary dressing forceps, a probe, or some similar instrument, as a female catheter. When the parts have been restored to their natural position, or as nearly so as is possible, care must be observed that no external pressure is employed by which they can be displaced. Plugging of the nostrils is useless. When the force has been severe and direct upon the nose, fracture of the skull may complicate the case—fracture either of the ethmoid bone forming the floor of the base of the skull, as has been illustrated in the chapter on injuries of the skull (Fig. 67), or fracture of the frontal bone. This latter form may generally be recognized by the swelling and crepitation of emphysema about the forehead, or the crepitus of the fracture with displacement, &c. Cases of fracture of the frontal sinus require no special treatment, and generally do well.

In children, the cartilage of the nose may be displaced from the nasal bones in consequence of an injury, and, unless replaced, permanent deformity and obstruction will ensue. The surgeon consequently, when this accident takes place, should do his best to restore the misplaced parts and to keep them in apposition, although some difficulty is often experienced in its accomplishment.

With the view of preventing or correcting deformity Mr. W. Adams has suggested, that the broken or bent septum should be straightened by strong plate-bladed forceps (Fig. 298*a* B) and the broken nasal bones raised, these parts subsequently being maintained in position by an ivory clamp, and the side of the nose pressed into place by a nose truss (Fig. 298*a* A) connected with a forehead plate (*a*) and band (*b*). The plates (*c*) are shaped according to the outline of the nose, and are made to diverge by rotating a central controlling screw, the pressure of the plates being regulated by two circular springs. The ivory clamp must be worn day and night for three or four days after the deformity has been corrected, and the nose truss for some months during the day.

FIG. 298*a*.



Forceps and nose truss for treatment of deformed nose.

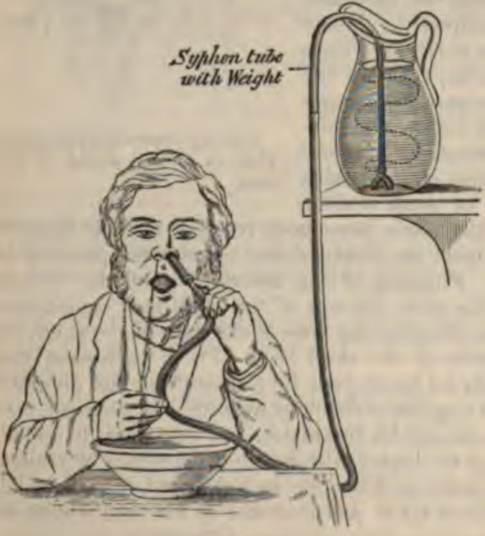
EPISTAXIS.

Bleeding from the nose is an occurrence of considerable frequency, and when not too free or lasting, rarely requires surgical interference. It may be the result of an injury—*traumatic ;* or associated with some cancerous affection or fibrous growth from the base of the skull or other local cause ; or, it may be the direct consequence of some fulness of the vessels of the head or heart disease. It is found also as a kind of *passive* exudation in anæmic and cachectic subjects ; after purpura or from hepatic disease, and also as supplementary to the catamenia.

TREATMENT.—In order to successful treatment its cause must be ascertained. When traumatic, it usually stops without aid. When due to plethora of the vessels from any cause, it is often salutary, and should be checked only when too copious or lasting. When of a passive nature it is serious, since anæmic feeble subjects cannot bear loss of blood, and the loss tends to aggravate its cause. In one case, therefore, saline purgatives may be of value ; in another, iron in full doses, or gallic acid in gr. v or gr. x doses. As to its treatment no definite rules can be laid down, it being a common accompaniment of so many different conditions, local and general.

When, however, life is threatened by its severity, real or comparative, the surgeon is bound to interfere. The head should be kept raised, and cold applied to the nose and frontal sinuses by means of ice when it can be obtained, as also to the nape of the neck being often serviceable. A steady stream of some cool saline liquid (a teaspoonful of carbonate of soda and common salt to a pint of water being as good as any), passed through the nostril, is a very effectual mode of treatment. For this purpose, the double-action India-rubber enema apparatus with a nose-piece to introduce into the nostril may be employed ; or Dr. Rasch's vaginal syphon douche, applied as in Fig. 299, the patient breathing at the time through the mouth, which should be kept wide open ; Professor Weber, of Halle, having discovered, years ago, that while the patient is breathing through the mouth, the soft palate completely closes the posterior nares, and does not permit any fluid to pass into the pharynx. The popular methods of placing the patient in the erect posture, and raising both arms above the head, may likewise be tried, as they are unquestionably good. If these measures fail, the nostril or nostrils must be plugged.

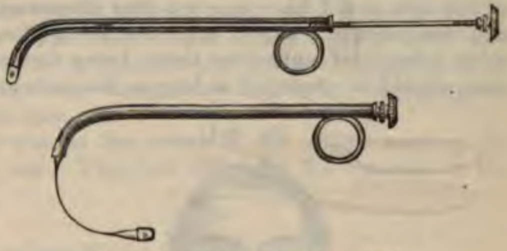
FIG. 299.



Nasal douche.

Plugging nose.—To do this effectually, some skill is necessary; to do it otherwise, is useless, if not injurious. To plug from the anterior nares alone is to trifle with the hemorrhage, and merely to mask the escape of blood as well as to direct it down the pharynx, under which circumstances, severe loss of blood may take place without knowledge. To perform the operation of plugging effectually, a plug of lint, cotton wool, a sponge tent, or compressed sponge an inch and a quarter long and an inch wide, should be prepared and fastened in the middle by a piece of strong silk or whipcord, an end about six or nine inches long being left. With Bellocq's canula (Fig. 300), a long-eyed probe, or an elastic catheter, a double thread of the same strong material should be passed into the nose along its floor through the posterior nares into the pharynx, and the loop caught either by the fingers or forceps and held while the instrument is withdrawn through the nostril. There will then be the loop hanging out of the mouth, and the two ends out of the nostril. The loop must then be fastened firmly to the pledget that has been prepared. This plug having been well oiled, is then to be drawn into the mouth by applying traction upon the ligatures protruding from the nostril, tilted with the finger behind and above the soft palate, and carefully adjusted or wedged into the posterior nares; by which means the escape of blood into the pharynx will be prevented. The two cords hanging from the anterior nares can then be separated, and the nasal cavity filled with compressed sponge, lint, or cotton wool which should be introduced between them, the whole mass being made secure by tying the two cords across the plug that has been introduced in front, and fastening them in a bow to allow of unfastening. When any styptic is deemed necessary, the sponge, cotton wool, or lint introduced into the anterior nares may be saturated with the solution of the perchloride of iron, tannin, matico, or a concentrated solution of alum. By this means the possibility of any escape of blood from either opening of the nose can be effectually prevented, and the most dangerous epistaxis absolutely controlled. Sir W. Fergusson once remarked that he had known, after plugging the nares, blood to ooze up along the nasal duct out of the canaliculi, but such "oozing tears of blood" must be very rare. To remove the apparatus, the knot at the anterior nares should be undone and the anterior plug taken out, the posterior being readily drawn from its position by means of the end attached to it in the pharynx; this end, which need not be more than six inches, may be left hanging down the patient's throat. The plug should not be left in more than three or four days, but may be reintroduced if necessary, the surgeon taking care to preserve *in situ*, the two pieces of cord that have been passed along the floor of the nose.

FIG. 300.



Bellocq's canula for plugging nostrils.

LIPOMA, OR HYPERTROPHY

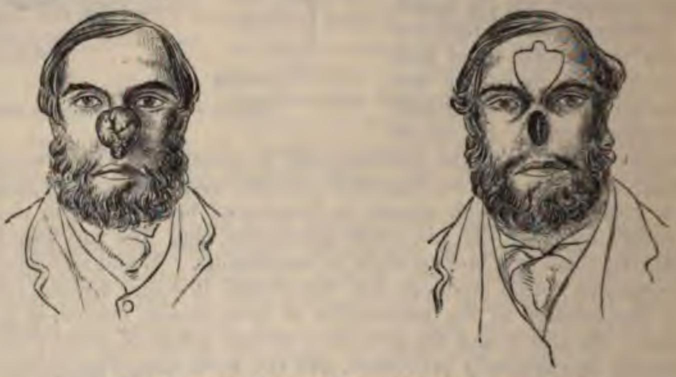
of the nose is a readily recognizable affection, and is a disease of the skin and subcutaneous tissue (not of the cartilages), in which the follicles freely participate. It is confined to the apex and alæ of the organ. The enlargement is sometimes general, at others, the swellings are pendulous, lobulated, and loose. The capillaries of the part are sometimes congested, giving the growth a purplish hue. As a rule, it is painless, and causes only mechanical annoyance. It interferes at times with vision and the functions of the nose, and, moreover, wounds vanity.

Nothing but the removal of the growth can be suggested, which can be done without danger and with no great difficulty. The redundant mass is to be dissected off, care being observed not to encroach upon the nostril. This is best done by introducing the little finger or a spatula into the nostril, and shaving the redundant mass off the cartilage with a scalpel. Any bleeding taking place can usually be checked by cold, styptics, or torsion; the wound that is left being allowed to granulate. The surgeon, however, should not take away too much or go too deep; and some covering to the cartilages should be left. The disease rarely returns. The late Mr. Hey, of Leeds, was the first to perform the operation.

LUPUS.

This affection is more common on the nose than in any other part of the body, and is often very destructive; so much so, indeed, as to destroy the whole organ. It is, however, more amenable to treatment than is usually supposed. Too often it is described as a strumous, and therefore constitutional affection, and regarded as incurable. It would be well, however, if surgeons would practically regard it more as a local one. The best local treatment in severe cases is the scraping away of the diseased surface with a blunt knife or the handle of a scalpel, followed by the free cauterization of the exposed surface, although in exceptional cases, excision may be performed. In milder forms, caustics are applicable, the potassa fusa being the best, dissolved in equal parts of water. The galvano-caustic or thermo-cautery is, however, superior to any. One of the worst cases of lupus of the nose that I have seen was that illustrated by Fig. 301. It had existed for years, and was cured in a month, after one free application of the galvanic cautery, every ulcerating tubercle of unhealthy tissue being freely destroyed. No caustic treatment, however, should be employed as long as the parts are inflamed.

FIG. 301. FIG. 302.



Lupus of nose, with the outline of a flap for a new nose. From life.

Tonic treatment, also, must not be neglected; while as a palliative application, cod-liver oil is very beneficial. Arsenic is also highly commended by Messrs. Hunt and others, and Donovan's solution when there is any syphilitic taint.

The lupus non-exedens may be regarded as an early stage of the lupus exedens; both have a papular origin and become tubercular—the tubercles ulcerating at a later stage.

EPITHELIAL CANCER AND RODENT ULCER

may attack the nose, the former usually appearing at first as a warty growth which subsequently ulcerates; the latter as a firm, uncolored, solitary nodule, which excoriates, then scales and bleeds, and finally ulcerates, deepening and extending the scabbed excoriation. In the epithelial cancer, the margin of the sore is more irregular and thicker than in the rodent ulcer, although until the lymph glands are affected it is somewhat difficult to distinguished between the two. Indeed, the epithelial cancer may be for long undistinguishable from the rodent cancer. The treatment of both, however, consists in the total destruction of the ulcerating surface and its edges, by cautery, escharotics, or the knife. I have treated many of the epithelial forms by means of the galvanic cautery with gratifying success. The disease, like other cancers, is, however, liable to return.

RHINOSCOPY.

The examination of the nasal cavity may be made through the nostrils by means of a speculum, or through the posterior nares by means of a mirror introduced behind the soft palate after the same fashion as in laryngoscopy, the parts being reflected from the mirror which is illuminated by sun or artificial light. Much aid may also be obtained by means of the finger. Czermak speaks highly of the value of a small mirror introduced through the nostril, which should be well illuminated. I have, however, found all the help I wanted in posterior rhinoscopy, taking care to draw forward with great gentleness the soft palate by means of forceps, but this method of examination is always difficult.

Diseases of the Nostrils causing Obstruction.

These are very common, and for such the surgeon is often consulted. In the infant, such a condition may be the result of congenital syphilis, which will be indicated by the history of the case and by the concomitant symptoms. The *snuffles* in infancy are very characteristic, and should always direct the practitioner to look out for some syphilitic affection. In isolated cases, such a symptom may be the only one of hereditary syphilis, and, by proper treatment, it may be cured without any other complication making its appearance; although, as a rule, if looked for, some cutaneous affection will be observed. A grain of gray powder with three or four grains of dried soda, twice a day, generally proves quite sufficient to cure the disease. When the mother is suckling, the child may be physicked through the mother, five or more grains of the iodide of potassium with quinine, given half an hour before suckling, three times a day, answering every purpose. Of late years, I have followed no other practice.

Warty growths are sometimes met with at the orifice of the nostril causing obstruction, and I have recorded such a case. They are cured by the removal of the growths.

Foreign Bodies in the Nasal Cavity.

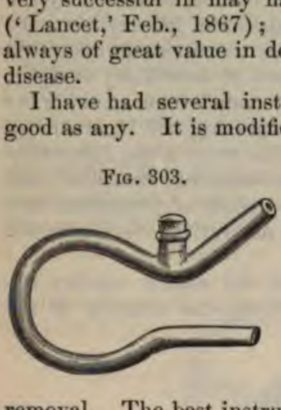
Whenever a child suffers from any obstruction to the nasal cavity, the presence of a foreign body should always be suspected, and the practitioner in such instances should never allow himself to be misled by the absence of a history of its introduction, since instances are not uncommon where some foreign body has been left in the nasal canal for many months. A child, four years of age, came under my care, who had suffered from all the miseries of an obstructed nasal passage for eight months, from the presence of a plum-stone. Many remedies had been tried but without effect, the foreign body being unsuspected. Its removal was rapidly followed by convalescence. Ulcerations of the mucous membrane from the inflammation excited by the foreign body, may tempt the surgeon to overlook the nature of the case. He should therefore remember, that such a disease as ulceration of the nose in children except at the immediate orifice, is by no means common, and that the probabilities of its being excited by a foreign body are very great. When only one nostril is affected, the diagnosis is more sure. The removal of these bodies when firmly impacted, requires some care, and the administration of chloroform cannot be too highly recommended, particularly when the child is young. A firm, hook-bent probe introduced down the floor of the nose, may be passed with facility behind the foreign body; or, a noose of wire, twisted or not, inserted along the septum and half turned, will generally, after one or two attempts, hook out the offending body. In some cases a pair of forceps will suffice. Gingerbread and other soft materials may have to be scooped out and the nose well syringed. I have never known any good result from syringing this cavity when any solid body has become impacted, except for the sake of cleanliness. Mechanical means always succeed, and are the simplest, particularly when the child is under the influence of chloroform. In older children and in adult life, obstruction to the nasal passage may be produced by many diseases; and when the presence of a foreign body is the cause, a true history of the case will generally be given, and thus the surgeon is more likely to arrive at a just conclusion as to the character of the disease.

Polypus Nasi.

This is a common affection, and may be found in one or both nostrils of the old or young. It may be of a simple gelatinous, fibro-cellular, or fibrous structure, or of a malignant nature. The gelatiniform and the fibro-cellular are by far the more common forms, and are not difficult to recognize; and, as a rule, spring from the middle turbinated bone and from its posterior portion, though they may grow from other parts. I have only removed one from the septum. They are seldom recognized in an early condition, since they cause no pain and but little inconvenience. A slight excess of discharge is the earliest symptom, and this is generally regarded as being the result of "cold;" but when this secretion is examined, it will be observed to be more serous than is found to exist in an ordinary coryza. The discharge continuing, may at last cause some anxiety to the patient, and, if the surgeon be consulted, a careful examination with a speculum should be instituted, when a polypus or rather a fringe of polypi, will often be observed on the margin of the middle turbinated bone. When the disease has been made out, removal of the growth is the only effectual treatment. Tonics and local astringents may for a time retard their growth, but rarely effect a cure. The use of tannin as a snuff has been very successful in may hands in causing the sloughing off of even the largest polypi ('Lancet,' Feb., 1867); but the remedy is uncertain in large polypi, although it is always of great value in destroying the smaller, and thus in checking the progress of the disease.

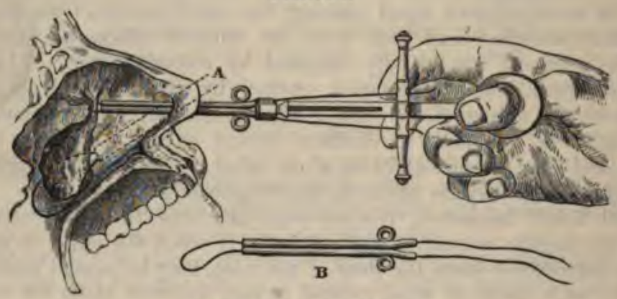
I have had several instruments made to apply the tannin, but the bent glass tube is as good as any. It is modified from one made by a patient for his own use, and answers well. The tannin is put into the small receptacle in the upper half, that end of the tube being inserted into the nostril, and the other into the mouth, and the patient then blows the tannin into his nostril.

Fig. 303.



The removal of the softer kinds of polypi should always be by abruption. Some surgeons employ a long pair of narrow well-made forceps which fix the pedicle, and then by a slight twist and some force, the removal of the growth is effected. When the polypus hangs far back, the introduction of the finger into the mouth and behind the fauces facilitates its removal. The best instrument known is the "noose," and that illustrated in Fig. 304 is the form I prefer. It is so constructed that a loop of wire introduced along the septum and half turned can be made to pass over the polypus and encircle its peduncle. The loop is then drawn home, the growth strangled at its neck, and abrupted. By these means the polypus is removed as a whole and bleeding is prevented; consequently, by the use of this instrument, the nose can generally be cleared at one operation. In some cases, I have cured the disease by cutting off with a long pair of scissors the turbinated bone from which these polypi grow. A few days after the removal of the polypi by the snare, tannin, as a snuff, may be employed.

Fig. 304.



Removal of polypus by noose.

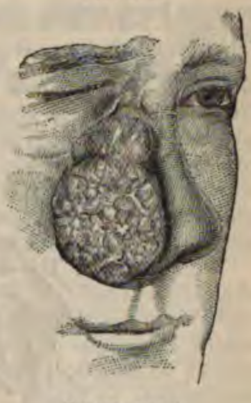
In severe cases in which this treatment has been employed with but poor success, Rouge's operation, as suggested by him for the treatment of certain cases of ozæna in 1873, may be performed, the operation consisting in the elevation of the upper lip and soft parts of the nose from their osseous attachments by means of an incission made beneath the lip through the mucous membrane where it is reflected from the lip into the gums, the lip and nasal cartilages by these means being so freed from their attachments as to allow the surgeon to lift them up as a whole towards the forehead, and thus reaching the nasal cavity for purposes of exploration or operation. To give more room, the septum nasi may require to be separate from its base. After the operation the parts readily fall into position, and should be kept there by strapping. No deformity or visible scar follows the operation.

This form of polypus seems to be more common in men than in women, and is a disease of young adult life. I have known it, however, in one instance, to appear in a man aged seventy-five.

The firmer and fibrous forms of polypi are by no means so common as the gelatinous, and seldom spring from the turbinated bones. They grow more frequently from the upper and posterior portion of the nasal cavity, from the top of the pharynx and the posterior nares, and have a periosteal origin. They do not make their appearance so early in life as the gelatinous, are far more serious in their nature, and more difficult to treat, on account of their position; but when removed, they rarely return. The best mode of treatment is to ligature them through the nose by means of a loop of whipcord or wire passed through the nostril into the pharynx and slipped over the growth. When this operation cannot be performed, the nostril may be laid open to give room for manipulation, or it may be necessary to remove the nasal process of the superior maxillary bone, or displace the body of, but not remove, the upper jaw itself, to reach the tumor. In 1865, I removed a large tumor of this kind which completely obstructed the posterior nares of a boy, æt. 14, by the ligature introduced through the nostril ('Path. Trans.,' vol. xviii), and in 1868, I removed a second from a lad, æt. 18, in the same way. In 1872, in another case, I took away a portion of the upper jaw to get at a tumor of the spheno-maxillary fossa which filled up the nostril from behind. Some of these polypi grow from the antrum and press inwards. The surgeon should bear this fact in mind in examining a case, as it may materially affect his treatment.

Cancerous tumors of the nose are found in practice, although not frequently. They may attack the body of the organ, as seen in Fig. 305, or grow from within and press forwards or backwards, filling in the anterior or posterior nares, when they are difficult to diagnose. They are, perhaps, more common in the old than in the young, although two cases have passed under my care in patients under thirty. They are generally associated with bleeding either from the nose or pharynx. When they grow from within, their removal, when it can be effected, is an expedient practice if only to give relief, and this can be done much in the same way as in the other varieties of polypi.

FIG. 305.



Cancer of nose.

Conditions simulating polypus.—The conditions of the nasal cavity which are not infrequently mistaken for polypus are, however, numerous. Many such have passed under my notice, the patients applying for the removal of such a growth, when in reality no growth existed.

Malformation of the septum nasi is one of the most common. In it the septum projects either into the right or left nostril, causing more or less obstruction to respiration, and leading a superficial observer to believe in the presence of some new growth. This deformity may sometimes be the result of an injury; and when so, there is generally some lateral twist of the nose itself. The knowledge of the existence of such a condition is quite sufficient to prevent any careful surgeon falling into this error. I need hardly add, that by no surgical treatment can this condition be remedied.

A chronic inflammation and thickening of the mucous lining of the nose is another condition which may be, and frequently is, mistaken for polypus. In it the patient complains of difficulty in respiration, and feels that there is something in the nose which mechanically impedes that function. On examining the cavity, a smooth, projecting, and firm outgrowth will be observed on its outer wall, which may be regarded as a polypus, but which is really only the lower turbinated bone covered by a thickened and inflamed mucous membrane. In a case such as this, if a little care be taken in sifting its history, it will probably be found, that an obstruction to the respiration will be the only symptom of importance; there will be no serous discharge, such as is so copious in cases of polypi, although there may be a discharge of tenacious mucus; yet this is not common; since the secreting function of the mucous membrane in these cases will generally be found diminished, and a great dryness present, accompanied by a loss of the sense of smell.

The best treatment in such examples is the constitutional, in the form of tonics, using that which appears to be more suited to the general wants of the patient's system. Some slight stimulating lotion such as the sulphate or chloride of zinc, or nitrate of silver of the strength of two grains to the ounce, may at times be required, but constitutional means alone are generally sufficient. Removal of the turbinated bone for this affection has been advocated and performed by some surgeons. I have adopted the practice in a few obstinate cases with marked success.

It is worthy of observation that this disease is at times confined to the mucous membrane over the lower turbinated bone; and for reasons which I am unable to explain.

The septum may likewise be the seat of inflammation either acute or chronic; and, as a result, great swelling of the soft parts covering it in will be present, giving rise to obstruction. When pus exists, an early opening is advantageous. In some cases, a perforating ulcer may appear; in others, exfoliation of the cartilage. I have removed from a boy, a *cartilaginous outgrowth* from the septum which obstructed the nostril, which had a base the size of a sixpence.

OZÆNA.

This term is applied to a large and important class of cases where an offensive discharge, or rather smell, is the common symptom, which is due to many different morbid conditions.

It has been said that this offensive smell is the result of some morbid secretion of the part, but my own experience has not furnished me with any information tending to confirm such an idea, and, I believe, that the fetor is generally, if not always, the result of the decomposition of retained mucus. At one time it may be associated with an ulcer of the mucous membrane; and at another, with some diseased bone the result of syphilis or otherwise; but, under all circumstances, the disease is an insidious one, and many months have usually elapsed before it comes under the notice of the surgeon or medical adviser.

The patient at first believes the symptoms to depend upon an ordinary catarrh; the discharge from the nose being thick, but not offensive, and the sense of smell more or less impaired. If these symptoms continue, the health of the sufferer often declines, and the physician is consulted on account of want of power, the local symptoms assuming a secondary importance. If the nose be examined at this time, as it should be, with a speculum, to obtain a good view of the whole, the only visible morbid condition will be, intense congestion of the mucous membrane, which will not be much, if at all thickened; this congestion of the mucous membrane being associated with excess of secretion.

TREATMENT.—The only correct and satisfactory treatment is the constitutional. When the general condition of the body is improved the local disease will disappear. To this end the hygienic conditions by which the patient is surrounded should be considered. If tonics, as quinine or iron, are indicated, they should be administered; the secretions also should be attended to, and all external and internal causes removed which may prove detrimental to health. The local treatment consists in absolute cleanliness and the removal of all retained secretions, and for this purpose there is nothing equal to the use of the douche (Fig. 299), saline medicated lotions being employed. The inhalation of steam will at times assist the removal of the secretion and relieve the state of fulness of the part, of which some patients so much complain. In other cases, the injection of warm water affords relief, especially if the discharges have a tendency so desiccate, adhere to the mucous lining, and, as a consequence, to putrefy; since it is this putrefaction of the retained muco-purulent secretion on which essentially depends the condition denominated *ozæna*. *Ozæna*, therefore, may be simply the result of a state like that which has just been described; and if so, must be treated on like principles. The offensive discharge must be removed by the free use of a douche or syringe, so that no muco-purulent secretion can be allowed to remain to decompose, and so one of the most troublesome symptoms of fetor will be removed and in future prevented. Medicated lotions are sometimes required, such as iodine lotion, Condy's fluid, carbolic acid, the sulphate or chloride of zinc, or nitrate of silver, in the strength of about one grain to the ounce of water. The inhalation of the fumes of iodine is always useful.

But ozæna does not always depend upon such simple local conditions. It may arise from some ulceration of the passage, an ulceration that may be seen through the speculum, and, if not seen, suspected to exist when an occasional escape of a blood-stained muco-purulent secretion takes place.

The principles of treatment under these circumstances are—tonics constitutionally, with cleanliness locally; topical stimulants being employed when simpler means have failed, or, when great indolence of the part is present.

These cases are, however, very obstinate, and much time is frequently required to bring about a cure—several months being often not long enough; but the fetor, which is the chief symptom of annoyance to the sufferer, may speedily be removed by the mechanical and local means already suggested, and so the worst feature of the disease becomes destroyed, and the mental as well as the physical comfort of the patient secured.

When, however, this inflammatory action and perhaps ulceration is allowed to continue, a different result will ensue; the bone itself becoming involved, and as a result necrosis follows. In so-called strumous subjects, this condition is not infrequent. I have no evidence to give that such a necrosis is always the result of the extension of the inflammation from the soft parts around the bone to the bone itself. In many cases, if not in the majority, I believe the disease originates in the bones.

Necrosis of bone in the nose is not an unfrequent condition, and, as such, is another cause of the disease described as *ozæna*. It is found in children as well as in adult life, and may be the result of injury, extension of disease from the soft parts covering the bones, or associated with the so-called strumous diathesis, or with the syphilitic poison. Occasionally it takes place without any such distinct cause, when it is described as idiopathic; it being well known that inflammation of bone may arise *per se*.

When ozæna is the result of necrosed bone, the fetor is generally of a peculiar character, such as is well known to accompany diseased bone; and under these circumstances, by careful examination with the speculum or probe, bare bones will often be detected, by which the nature of the disease becomes tolerably evident. In early life, I believe that inherited syphilis is a more frequent cause of this affection than is generally suspected, and this opinion has been confirmed by the presence of other marked symptoms in some cases, such as old skin diseases, syphilitic teeth, or keratitis.

To form a correct opinion in all cases of ozæna, a careful history of the case must be obtained and well-known symptoms not overlooked, for unless an accurate knowledge of the case can be acquired, the treatment adopted must be doubtful, and consequently unsuccessful.

TREATMENT.—When the presence of necrosed bone has been made out as the cause of the disease called ozæna, it is tolerably evident that the patient will not recover until the fetid bone has been removed, or rather has exfoliated. To this end, the preservation of perfect cleanliness by means of the douche or syringe, with or without stimulating or antiseptic lotions, may be employed, and tonics administered. If syphilis, either hereditary or acquired, is the apparent cause, our remedies must be modified to the general requirements of the patient. Mercurials are seldom necessary, although in children suffering from this disease, where the history and other symptoms of congenital syphilis are present, I have given them, associated with tonics, with marked benefit, and, in obstinate cases in adult life, such a combination may also be employed. The perchloride and green iodide have proved the best forms in my experience, and, when combined with tonics such as quinine, bark, or iron, are invaluable. I generally prescribe the perchloride with bark, and the iodide in pills at bedtime, the patient taking at the same time the syrup of the iodide of iron and the iodide of potassium in some bitter infusion, such as quassia. If mercurials are not indicated or required, the combination of the iodides of iron and potassium cannot be too highly valued.

In strumous subjects, perfect local cleanliness, and perhaps stimulants, accompanied with tonics, as cod-liver oil, quinine, or iron alone, or in combination, generally suffice.

NASAL CALCULI OR RHINOLITHES.

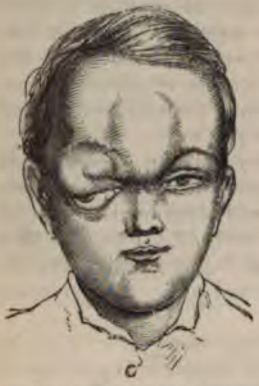
Such cases have been recorded though I have never seen an instance. They may be small or so large as to obstruct the nostril, and may be formed around foreign bodies introduced from without. Obstruction and more or less pain are said to be the chief symptoms, and occasionally a copious discharge of mucus or pus. The calculus can be detected on examination, and, when found, it should be removed by douche, snare, or forceps. Cases are on record in which the concretion was crushed before removal.

DISEASE OF THE FRONTAL SINUS.

The frontal sinuses, as part of the nose, are liable to many of its diseases. Acute or chronic catarrhal inflammation is by no means uncommon; both giving rise to a dull heavy pain over the forehead, which the inhalation of the fumes of half a grain or more of opium thrown on a hot piece of metal often speedily relieves.

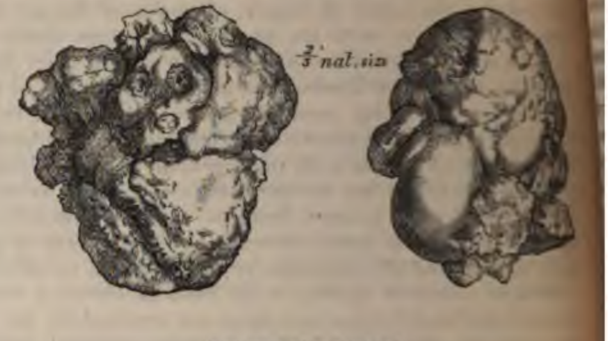
Acute suppuration of these sinuses is occasionally met with, and is attended with severe local and general symptoms. Under these circumstances, the application of the trephine to the outer shell of bone may be required. Necrosis of the bones covering in the sinus may exist, and the latter are also liable to fracture. New growths may likewise be found in this locality—cancerous, myeloid, or bony; *the ivory osseous growths* being more frequently found in the air-cells of the frontal bone and nasal fossæ than in any other locality. From modern investigations they appear to have a periosteal origin and soon become loose. In Hilton's well-known case, the growth sloughed away. In the case from which Figs. 306 and 307 were taken, the osseous mass was evidently dying when it was removed.

FIG. 306.



Enostosis of frontal sinus.

FIG. 307.



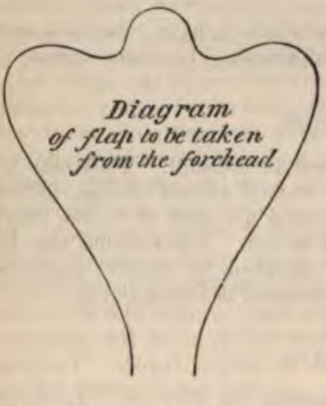
Enostosis after removal.

It had been growing in the frontal sinus of a man, æt. 24, for four years, and had gradually encroached upon the orbit. I enucleated it from its bed by means of an elevator, after having taken away the layer of frontal bone that covered it in. A good recovery ensued ('Guy's Hospital Reports,' 1873–4). M. Olivier's treatise upon the subject, published in Paris in 1869, gives all the facts known about such growths. In all tumors occupying the centre of the frontal region in children, the possibility that any one may be a hernia of the brain or its membranes should be borne in mind.

RHINOPLASTIC OR TALIACOTIAN OPERATIONS.

Gaspar Tagliacozzi, or Taliacotius, Professor of Anatomy and Surgery in the University of Bologna, was the first to bring these operations into notoriety, and they have consequently been named after him. He was not, however, the originator of the operation, as he himself refers to earlier men, such as A. Paré and others, who have recommended it, but he was the first to practise it with much success, and quite deserves the fame that attended his efforts. His principal work, published in 1597, at Venice, only two years before his death, gives the histories of the cases in which he operated.

FIG. 308.

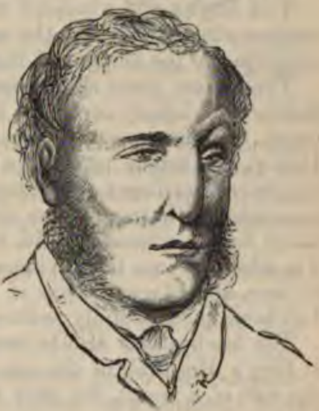


His method consisted essentially in taking a flap of skin from the arm and transplanting it to the nose, and so restoring that organ to its normal appearance where there had been any loss of substance.

Modern surgeons, instead of following the great Italian example, generally prefer to adopt the Indian method, and take the integument from the forehead. The operation is by no means common. It may be undertaken to restore the nose wholly or in part, and the amount of healthy integument required for this purpose will be regulated by the want. The ingenuity of the surgeon too will be taxed in every case, to adapt his operation to its special requirements. He must, however, always be careful to give himself abundance of new material; and, having satisfied himself of the wants of the individual case, and that the parts upon which he is about to operate have long lost all traces of disease, he can then map out upon the centre or lateral portion of the forehead of the patient that portion of integument he proposes to transplant, having planned it beforehand on a piece of paper, plaster, or wash-leather. The shape required for a nose and columna will be such as is indicated in Figs. 302 and 308, the flap measuring three inches in both diameters. The surgeon shall then make raw the whole surface of the old nose to which the flap is to be united, cutting a deep groove close down to the bones bounding the nasal cavity for the reception of the new flap. A sponge may then be firmly pressed upon this raw surface to arrest the bleeding, while the surgeon proceeds to dissect up the integument he had previously marked out upon the forehead. In doing this, care should be observed not to bruise or otherwise injure this borrowed skin. The incision should be clean and extend down to the bone. The flap should be dissected up boldly and freely, care being observed to leave a good neck through which the circulation can be maintained, and to make it long enough to allow of its being turned round. For this purpose, it is a good practice to make the incision on the side to which the twist is to be made a little longer than the other.

When all bleeding has ceased, the frontal flap with the external surface still uppermost should be turned half round, and applied to the nasal raw surface, to which it is to be carefully stitched; the columnar portion being well pressed down into the groove made for it, and fixed. The new nostrils ought to be supported by oiled cotton wool or lint, and the surface covered with the same material to maintain its warmth. The gaping wound on the forehead can then be brought together as far as possible by means of strapping, and left to heal by granulation—the operation of skin-grafting expediting repair. The sutures may be removed on the second or third day. For the next month, the greatest care is requisite in the dressing of the wound, and in keeping the nostrils up with a plug, the one suggested by Langenbeck being the best; and, as soon as the new flap has consolidated, the neck of integument at the root of the nose may be divided. In the case illustrated (Fig. 309), such a practice was not called for. I operated upon it in 1872 with an excellent result. When the formation of the columna is required, Liston's plan is the one generally employed, and is thus described in his own words:—

FIG. 309.



Appearance of face after formation of new nose.

"Restoration of the columna is an operation which, in this and other civilized countries, must be more frequently required than the restoration of the whole nose. This latter operation came to be practised in consequence of the frequency of mutilations as a punishment; but the punishment for some of our sins is left to Nature, and she generally relents before the whole of the organ disappears. This columna is frequently destroyed by ulceration. The deformity produced by its loss, is not far short of that caused by destruction of the whole nose. Happily, after the ulceration has been checked the part can be renewed neatly, safely, and without much suffering to the patient. The operation which I have practised successfully for some years, and in many instances, is thus performed: The inner surface of the apex is first pared. A sharp-pointed bistoury is then passed through the upper lip—previously stretched and raised by an assistant—close to the ruins of the former columna, and about an eighth of an inch on one side of the mesial line. The incision is continued down, in a straight direction, to the free margin of the lip; and a similar one, parallel to the former, is made on the opposite side of the mesial line, so as to insulate a flap about a quarter of an inch in breadth, and composed of skin, mucous membrane, and interposed substance. The frænulum is then divided, and the prolabium of the flap removed. In order to fix a new columna firmly and with accuracy in its proper place, a sewing needle is passed from without through the apex of the nose, and obliquely through the extremity of the elevated flap; a few turns of thread over this suffices to approximate and retain the surfaces. It is to be observed that the flap is not twisted round, as in the operation already detailed, but simply elevated, so as to do away with the risk of failure. Twisting is here unnecessary, for the mucous lining of the lip, forming the outer surface of the columna, readily assumes the color and appearance of integument, after exposure for some time. The fixing of the columna having been accomplished, the edges of the lip must be neatly brought together."

The sutures can be removed on the third or fourth day, when, as a rule, the parts have cicatrized. The ultimate result of the case depends materially upon the care bestowed upon its after-treatment. In the case illustrated in Fig. 309, which I operated upon several years ago, a gratifying result ensued, the bridge of the nose requiring no second operation. Dr. Lichtenberg has had within the last few years some very successful cases; and the late Mr. Skey had some excellent results in his practice. I saw one that he had operated upon years before, which was very excellent. It is well, however, to remember Mr. Skey's advice when he says, "Let it be the patient who urges the operation."

Of late years, Langenbeck has suggested the propriety of dissecting up the periosteum from the frontal bone with the skin flap so as to give a bony nose, but it is a question how far this osteo-rhinoplasty is an advantage. The operation has not found much favor.

When only one ala has to be restored, the flap may either be taken from the nose itself or from the cheek, the particulars of the plan being left to the ingenuity of the surgeon to determine.

CHAPTER XVIII.

SURGICAL AFFECTIONS OF THE LARYNX AND TRACHEA.

The larynx and windpipe may be contused from external injury, or the cartilages and trachea rings fractured; the severity of the symptoms following these accidents varying according to the amount of injury to the parts.

Thus, some years ago, a case came under my care in which the thyroid cartilage was fractured obliquely across its body. The accident was attended with much bleeding and cough, but these soon disappeared, and an excellent recovery ensued. In 1877, Dr. A. Corley, of Dublin, recorded a case, in which after death the second, third, and possibly the fourth cartilages of the trachea were fractured and projected unevenly into the tube, associated with suppuration around a necrosed cricoid cartilage. The preparation was taken from a woman, æt. 36, who had been squeezed in the throat some *weeks* before, and was admitted into the Richmond Hospital with dyspnœa, stridulous breathing, congestion of face, and external signs of inflammation about her throat, and for which tracheotomy had been unsuccessfully performed.

The trachea may also be *completely divided subcutaneously*. I saw this in June, 1876, at Guy's Hospital, in the case of a man, æt. 47, who was crushed between a barge and the side of a vessel, the prow of the barge striking his neck. The accident was followed by dyspnœa and some emphysema of the neck, but the symptoms were not urgent so long as the erect position was maintained, but the recumbent was impossible. The man lived fifty hours and died quietly. After death, the trachea was found to be completely severed below the thyroid body; the two ends being separated for an inch and a half, while the lower end was below the innominate vein.

There was no external bruise to denote the severity of the injury.

WOUNDS OF THE THROAT.

These are generally made by the hand of the suicide, and consequently have a double interest; the dangers of the local injury being complicated with the peculiar mental condition of the sufferer. It is essential, therefore, for the surgeon to dwell seriously beforehand upon the necessities of these cases, in order that in the hour of danger he may be prepared to act with energy and decision.

In the majority of cases of "cut throat" the wound is only of a superficial nature, and simply involves skin, or skin and muscle, and does not implicate either the pharynx or the respiratory tract. These cases require no other local treatment than that usually employed for skin wounds, such as sutures and warm-water dressing. When the wound is of a deeper character, it may penetrate into the pharynx and air-passages, or involve the deep vessels, the dangers of the case being much determined by the position of the wound.

My colleague Mr. Durham, in an able article in 'Holmes's Surgery' (second edition), asserts, that of 158 unselected cases the wound was

Above the hyoid bone in	11 cases.
Through the thyro-hyoid membrane in	45 "
Through the thyroid cartilage in	35 "
Through the crico-thyroid membrane in	26 "
Into the trachea in	41 "

The respiratory tract was opened in about two-thirds of the cases.

In all cases of cut throat, *hemorrhage* as the direct result of a divided or wounded artery or vein is to be apprehended; and, although from the deep position of the carotid artery and jugular vein these vessels in the majority of cases escape injury, yet when they are divided death is usually rapid. Partial or complete division of some of the branches of these vessels is, however, not unfrequent.

A man in Guy's, æt. 21, in a fit of despondency cut his throat, and died from profuse hemorrhage into the lung before help could be obtained. The blood was found after death to have come from a divided superior thyroid artery. An inmate of St. George's divided the left common carotid artery and wounded the internal jugular vein with a penknife, and died before the house surgeon could arrive. "A gentleman, who committed suicide by cutting deeply between the os hyoides and thyroid cartilage, partially divided the external carotid artery on the right side, just as it was given off; the flow of blood was immense, and he was found dead within ten minutes of the infliction of the wound." (Fothergillian Prize Essay for 1836, by my father, the late Mr. T. E. Bryant.) In Guy's Museum, Prep. 1711^{79}, the left internal jugular vein may be seen divided; the cut being between the thyroid and cricoid cartilages, and proving speedily fatal. The Prep. 1711^{9} shows a division of the inferior thyroid artery.

Blood may flow into the trachea, and, suddenly or slowly, cause asphyxia; it may coagulate over the orifice of the larynx with the same result. Mr. Le Gross Clark has also shown ('Surg. Diag.,' 1870) how air may enter the circulation through a partially divided vein and destroy life in twenty-four hours.

When the incision is *above the hyoid bone* and deep, the tongue may be divided, and the loosened portion by falling over the orifice of the larynx may cause sudden death by suffocation. In wounds of this description, the surgeon should consequently guard against the possibility of this contingency taking place by passing a thread through the tongue and drawing it forward.

Again, when the cut is *just above the thyroid cartilage*, the epiglottis may be divided, and this falling into the larynx may cause fatal dyspnœa. To prevent this a stitch should be inserted into the divided portion and the parts adjusted. The same result may take place when any portion of the orifice of the larynx has been detached. Indeed all loose bodies likely to obstruct respiration should be fixed. Emphysema is by no means an uncommon complication of cut throat when the respiratory tract has been opened, and is not, as a rule, a dangerous occurrence. It is more common when the external wound is small.

Inflammation of the air-tubes and lungs is the secondary danger of wounds of the throat involving the air-passages; and, when the pharynx or œsophagus has been opened this risk is aggravated by the possible introduction of food into the trachea. Purulent infiltration of the cellular tissue of the neck may also ensue, or œdema of the glottis; and, at a later date, the air-passages may be obstructed by the cicatrization of the wound or the contraction of the trachea. In exceptional cases a permanent fistulous opening may be left.

The immediate danger of a wound in the throat consequently depends (1) on the quantity of blood lost; (2) on the risk of suffocation from that blood flowing into the air-tube; (3) the danger of suffocation by tissues divided and partially separated from their connections obstructing the larynx. The secondary dangers are those of œdema of the larynx and inflammation of the air-passages, and, later on, from subsequent narrowing of the divided tube by the contraction of new tissue around it.

TREATMENT.—The first duty of the surgeon under all circumstances is to *arrest hemorrhage*. Arteries ought to be ligatured or twisted, as all deep veins when moderate pressure fails to check the flow of blood. A wounded artery or vein should be ligatured above and below the wound. A small wound in the internal jugular vein must be tied with a fine thread.

The second duty of the surgeon is to *prevent suffocation*. He should see that the respiratory orifice is kept clear of blood or of any divided structure such as the tongue or epiglottis. Coagula ought to be speedily removed, and respiration encouraged by artificial means when natural processes have failed.

When the larynx or trachea has been wounded, the aim of the surgeon should be to keep the divided pieces of the tube in continuity and not to allow the upper portion to overlap the lower, and thus obstruct the respiration; at the same time, care must be taken to keep the wounded parts sufficiently open to allow of the escape of the mucus which is always profuse, and to prevent the free ingress of air.

If the wound is very extensive, and difficulties arise in carrying out the above indications, sutures may be introduced; but it must be left to the surgeon's judgment to decide when they may be necessary, according to the exigencies of the individual case. In large wounds where the parts cannot be kept together, a suture is often of immense benefit, and sutures when applied should be put in firmly, including often the whole thickness of the tissues. Their object can only be to fix the divided parts in position, and to prevent, by their sudden movement, any mechanical obstruction to the respiratory act. To do this effectually, the measures employed should be boldly executed. The head should be kept forward by the application of bandages, and water dressing applied to the wound itself; constant attention is demanded of the nurse to keep the wound clear of discharge, and to see that no obstruction to the breathing takes place. The atmosphere the patient breathes should be kept warm and made moist by the introduction of steam, and the wound covered with muslin. The closest attention should be paid to the patient by a skilful nurse, and every mental and bodily want or weakness cared for. As regards nourishment, abundance should always be provided, although it is not such an easy task for the patient to take it.

When the pharynx or œsophagus is extensively opened, the patient should never be allowed to swallow, but be fed by means of a tube passed either through the nose or mouth, and not through the wound, and directed with the finger carefully down the throat into the lower portion of the œsophagus. Through this, beef-tea, eggs, brandy, and other liquid nourishment, such as the symptoms indicate, may be periodically administered. I have an instance before me where the pharynx was extensively opened above the os hyoides, and where the patient was kept alive by such means for nearly six weeks, the tube having been passed through the nose. At the end of this time he was able to swallow, and recovery ensued. When acting as dresser to the late Mr. Aston Key, I had a case where the wound was inflicted through the trachea, dividing the œsophagus. In this instance the man was fed twice daily through a tube passed through the mouth and directed with care into the lower œsophageal opening; this practice being carried on for many weeks, was rewarded by recovery. The plan of treatment just indicated, however, is only rational, and is such as any surgeon would naturally suggest. All complications, such as suppuration in the cellular tissues around the wound, bronchitis, or broncho-pneumonia, are to be dealt with as they arise. Some have suggested the propriety of tracheotomy in severe cases of cut throat, so as to allow the wound to be closed. I am unable, however, to see the advantages offered by this practice in ordinary cases; although in wounds involving the epiglottis or upper part of the larynx, when inflammatory œdema appears as a secondary result, causing obstruction to respiration and threatening life, there is no doubt as to the wisdom of the practice. These cases, however, are uncommon.

Among the most remote dangers of such wounds, the mechanical obstruction of exuberant granulations ought to be mentioned; likewise, some narrowing of the air-passage, as a consequence of contraction of the cicatrix, or tracheal fistulæ. These results are common to traumatic and surgical wounds of the part. In Prep. 1711^{11}, Guy's Hosp. Museum, both the trachea and œsophagus are much contracted above the opening, and, in a less degree, below. This preparation was taken from a patient who had lived for many years after a wound which had involved both the trachea and œsophagus. In 1873, I was called upon to perform tracheotomy on a man, æt. 57, who had cut his throat through the thyroid cartilage sixteen months previously, and for eight or ten months had been suffering from gradually increased difficulty of breathing, due to the contraction of the air-passage, and this patient has ever since been obliged to wear the canula. In the seventh vol. of the 'Clin. Soc. Trans.,' an interesting case of the kind has been recorded by Mr. H. Lee.

FOREIGN BODIES IN THE WINDPIPE.

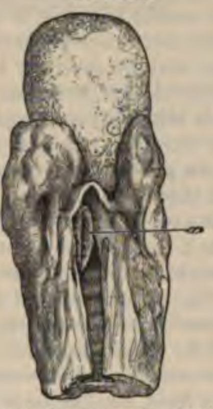
There are few accidents which excite more anxiety and alarm to a looker-on than the passage of a foreign body into the larynx or trachea. The unfortunate subject, in the midst of apparent health or happiness, is suddenly forced to make violent struggles for life, and to the spectator death seems imminent. In the surgeon's mind no less painful feelings are excited, for unless by his art timely relief can be afforded, the danger which is apparent becomes real, and death becomes almost a certainty.

The majority of the victims of such an accident are children, although adults are not exempt from such a contingency.

A foreign body may be inhaled at any moment, sudden inspiration being sufficient when the mouth is full, and especially when that foreign body is smooth, light, or small, such as a fruit stone, bead, bean, nut, or coin. Vomited matter may likewise be drawn by inspiration into the air-tubes by patients in a state of unconsciousness, as when under chloroform, or in an epileptic fit, and so produce death, or through fistulous openings between the œsophagus and trachea, the result of simple or cancerous ulceration. The body may be lodged at the orifice of the larynx (Fig. 310), and thus cause sudden asphyxia; or pass into the rima, where it may be arrested, or into the trachea or bronchi, the right bronchus being its most common seat. The size and shape of the foreign body determine many of these points; for whilst a large one will naturally be arrested at the orifice of the larynx, a small one will probably pass through; and a jagged and light body, such as a piece of nut-shell, would be more likely to be caught in the rima than a small round body, as a bean.

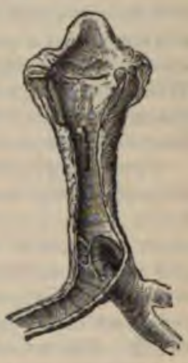
A piece of meat may become impacted in the rima glottidis and cause instantaneous death (Prep. Guy's Hosp. Mus. 1710).

FIG. 310.



Bone in larynx causing death, taken from a child 11 months old. Prep. 1710^{a}.

FIG. 311.



Date stone impacted in right bronchus. Prep. 1717^{1a}.

In the case of a child, æt. 2½, on whom I unsuccessfully operated in 1864, a date stone was found impacted in the right bronchus, while its upper end was pressing against the left side of the trachea, and exciting ulceration (Fig. 311). The child lived four days. In another case recorded in my 'Clinical Surgery,' Part II, a bean was firmly impacted in the right bronchus, causing complete obstruction to the right lung.

The fact that the septum at the division of the trachea is somewhat to the left of the median line is probably the explanation of the right bronchus being more frequently the seat of the foreign body than the left. This was pointed out by Goodall, of Dublin. The larger size of the right bronchus doubtless favors this tendency.

The symptoms which attend the entrance of a foreign body into the air-passages are somewhat characteristic, although those that follow are often obscure. The most typical is a violent convulsive cough *coming on abruptly*, followed by difficult respiration, and a feeling of suffocation—this spasmodic cough being likely to recur at intervals on any movement.

When the voice is altered in character, *whistling* or *stridulous*, it is suggestive of the foreign body being near the rima, and impacted; and when there is tenderness of the larynx on manipulation or pain, this suspicion is strengthened. When an extraneous body is in any part of the larynx, but more particularly in the ventricles, the spasmodic derangement to which it gives rise too often proves speedily fatal. In children, rapid suffocation is a common result of such a cause, death being more from spasm of the glottis than from mechanical obstruction by the foreign body.

When the breathing of the patient is at times natural, and at others disturbed by a paroxysm of cough or dyspnœa, and when these symptoms are brought on by any movement or violent respiratory effort, it is probable that the foreign body is loose in the trachea or one of its divisions; indeed, patients are conscious occasionally of the movement of the body. When by auscultation it can be made out that air enters one lung freely and the other feebly, the exact seat of impaction of the foreign body is indicated, and the amount of dyspnœa present will depend upon the closeness of the impaction.

When the extraneous body has passed through the larynx into the trachea, there may be long intervals of repose between the attacks of laryngeal spasm; but any spasm may prove fatal.

Many cases are now on record in which foreign bodies, particularly coins, have been impacted in a bronchus, and have given rise to no urgent symptoms for years. Dupuytren in one of his lectures given in 1833 relates a case where a coin was known to have been in the air-passage for ten years without producing any very distressing effects, and was found after death to occupy a tubercular excavation. Professor Gross gives a case in which a portion of bone is said to have been coughed up, after having been retained for sixty years. Cases such as these, however, should never allow the surgeon to rest satisfied, or permit a foreign body to remain in the air-passages; for so long as it does, death may at any moment be produced by sudden convulsive laryngeal spasm.

Difficulty of breathing is not uncommon as a consequence of the arrest of food in the œsophagus or lower part of the pharynx, and at first sight the surgeon might think that the symptoms are due to the presence of some foreign body in the air-passage. When doubt exists, the patient should be made to swallow; in laryngeal obstruction no difficulty will be experienced by the act, whereas in pharyngeal it will be impossible. Under other circumstances a probang may be carefully introduced into the œsophagus, and, in every case, a careful exploration of the throat and pharynx with the finger should be made. When the foreign body is impacted in the pharynx and cannot be removed, and laryngeal spasm threatens life, the windpipe may require to be opened. The surgeon should always hesitate to employ force in pressing a foreign body downwards.

TREATMENT.—Given the diagnosis of a foreign body in the windpipe, the duty of the surgeon plainly is to endeavor to remove it. There should be no deviation from this resolution, because so long as a foreign body remains in the air-passage sudden death is imminent, as spasm of the larynx may be produced by any movement of the foreign body, and any may prove fatal. The surgeon should never allow himself to be misled by the mildness of the symptoms nor by the knowledge that in rare instances foreign bodies have remained in the passage for years, and even then been expelled, as such cases are exceptional. The accident is one that will inevitably destroy life, although it must be doubtful at what time, or in what form, danger may appear.

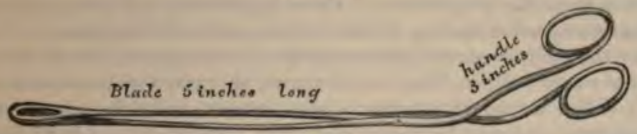
In all urgent cases in which spasm of the larynx threatens life, ***tracheotomy*** should be performed; because with an opening in the trachea, a fatal spasm is impossible, and the surgeon may then proceed to investigate the case. In cases in which life appears to be extinguished, the same practice should be adopted, artificial respiration being subsequently maintained. Should the symptoms point to the larynx as the seat of the impaction, the upper orifice should be closely examined by the finger introduced through the mouth, and a full-sized bougie or catheter introduced from below through the wound into the larynx. By these measures most foreign bodies caught and impacted in the larynx itself may be removed. In exceptional cases where these measures fail, the surgeon may be called upon to lay open the larynx. The laryngoscope at times will be an invaluable aid in guiding to the position of the foreign body and in effecting its extraction. It is only applicable, however, in adults. When the position of the foreign body is known, its removal may be facilitated by curved forceps.

In children, the opening in the trachea should always be as high as possible, and there is no objection to dividing the cricoid cartilage (*laryngo-tracheotomy*) to reach the larynx. Laryngotomy is scarcely applicable to these cases, the majority being found in children. When the foreign body is so fixed in the larynx as to be immovable by the means suggested, the thyroid cartilage must be laid open by increasing the incision upwards. In doing this the larynx will be fully exposed, and the removal of the body facilitated. When the foreign body has passed the larynx and is in the trachea, a free opening should be made low down in the passage, which, when done, it not unfrequently happens that the foreign body is expelled. If not, the patient may be inverted, and succussion employed, that is, the patient should be patted sharply on the back or shaken with the view of dislodging it.

Some surgeons advise the introduction of forceps or other instrument through the wound into the trachea for the removal of the foreign body, and in recent times success has followed the practice. Thus in May, 1876, Mr. Maunder extracted, by means of a loop of silver wire through an opening made in the trachea, a glass sleeve link from the left bronchus of a boy æt. 13. Mr. Hulke, in August, 1876, hooked out of the right bronchus of a woman, æt. 37, the outer tube of a tracheotomy canula by means of a piece of German silver wire bent into a hook; and Mr. Lucas, on November 16, 1877, removed by means of forceps the same kind of thing from the left bronchus of a man, æt. 57, the tube having been in the bronchus for seven weeks.

Fig. 312 represents an excellent pair of forceps for this purpose. It was made for Dr. S. D. Gross, of Louisville, before 1854, and is taken from his book on 'Foreign Bodies assages.' "They," as described by him, "are composed of silver, and are a ds of eight inches in length. The handle is considerably curved on the flat, large rings for the thumb and finger. The blades, which are rounded and r, are five inches long and terminate each in a fenestrated extremity, nine

Fig. 312.



Gross's trachea forceps.

gth by three lines in width, the outer surface being smooth and convex, the nd slightly serrated. The blades when shut slightly overlap each other. The he instrument is a little over five drachms. The instrument, being long and y be used as a probe; being composed of silver may be bent at any point and ction; and being delicate cannot impede the passage of air during its use."
ese means fail to remove the foreign body, the patient must be left; but the he air-tube should be kept open.
reign body be in the larynx, the canula may be introduced, but when in the bronchus, such a practice is injurious, as preventing the escape of the sub- nder these circumstances Hilton's suggestion is undoubtedly the best—the for- transverse valvular opening in the trachea, which readily allows of the escape gn body when impelled against its surface. The cutting out of a portion of is quite unnecessary. The tracheal wound can also be held open by hooks, or ligatures. In one case in which the trachea was deep I managed to keep the und open by means of a divided ring of strong wire embracing the neck, its eing made to hook into the opening into the air-passage, and acting as retractors. I held the wound apart by means of a wire instrument made on the principle peculum. When efforts fail at one time for the removal of the body, they may be t another. Mr. Brunel's well-known case is one in point. Mr. Durham informs analysis of 554 cases of foreign bodies in the air passages, that death resulted o per cent. when no operation was performed, and in twenty-four per cent. tive measures were resorted to; and hence the chances are greatly in favor of ractice. The foreign body having been removed, the chief danger has passed. be some inflammation of the air-passage as a result of the irritation of the ly, but this usually subsides on the removal of its cause. In exceptional may prove troublesome if not fatal. The nature of the substance has also nce in determining this result, smooth bodies being slightly irritating, while more so. The operation of tracheotomy doubtless does something towards this condition. Such a complication should be treated on rational principles, majority of instances, the inflammation will subside spontaneously on the the offending body. Water dressing to the wound, and a warm, moist atmo- the two essential points of practice to be followed after the removal of the as a rule, convalescence speedily follows. Chloroform ought always to be d in these cases when operative interference is called for.

SCALD OF THE LARYNX.

newhat common accident is engendered amongst the poor from the habit of ir children out of a teapot. The child, when thirsty and alone, being accus- ink from the "spout," tries the same experiment with the kettle of boiling scalds the pharynx and orifice of the larynx so that œdematous inflammation follows, in the same manner as a blister arises by the application of boiling am to any other tissue.
ptoms caused by such an accident appear, as a rule, very speedily, the small e glottis soon closes, and, as a consequence, a fatal result ensues unless early e obtained.
cases, the mouth, with the soft palate, tongue, and fauces, will be found swollen ed. There will also be difficulty in swallowing, and some alteration in the

character of the voice. The respiration rapidly becomes affected, and a spasmodic croupy cough appears, with stridulous breathing. These symptoms may become gradually or rapidly worse, and may be complicated with attacks of spasmodic dyspnœa, at long or short intervals; but when these attacks appear, the condition is extremely dangerous, as any spasm may prove fatal. A somewhat similar result may arise from the intentional or accidental swallowing of any corrosive poison or acid, or from the inhalation of a flame.

TREATMENT.—In a fair proportion of these cases little other treatment than a warm bed, the application of a hot sponge to the larynx, and the inhalation of warm moist air is ever needed; the symptoms subside as rapidly as they appear, three or four days seeing the worst of the case; and, in these mild cases, the laryngeal symptoms are probably never severe. When laryngeal symptoms exist, accompanied by spasm, the case assumes a threatening aspect; indeed, the first spasm may be the last. I have notes of the case of a child in whom the symptoms were so slight that no anxiety was felt, but a single spasm took place two hours and a half after the accident, and put an end to life.

When symptoms are severe, the operation of tracheotomy should be performed; indeed, I am disposed to recommend this operation in every case in which the symptoms are rapidly progressing, and laryngeal spasms coexist. To postpone it too long till the lungs become gorged with blood, and, consequently, disposed to inflammatory action, and the powers of the patient are depressed, is a timid and certainly unsuccessful practice. In the opinion of many good surgeons, I know it is thought desirable to postpone operative interference as long as possible—"to watch and wait." In this I do not agree. When laryngeal spasms exist with mechanical obstruction, nothing but opening the windpipe places the patient in safety. Out of nine cases consecutively treated by tracheotomy, five recovered. The statistics, however, of my colleague Mr. Durham are less favorable, twenty-three out of twenty-eight cases terminating fatally. In some instances, the scarification or puncturing of the œdematous opening of the larynx and epiglottis gives great relief. I have been accustomed to do this by means of an ordinary tenaculum or mounted needle. Mr. Tudor, formerly of the Dreadnought, has invented a useful instrument for the purpose, called an epiglottome. The punctures into the œdematous tissue may be free, and never seem to do harm. Drs. Wallace and Bevan, of Dublin, have spoken very strongly in favor of the calomel treatment, two or three grains being given every hour until the symptoms are relieved; and Dr. Croly uses inunction at the same time. Other surgeons speak well of antimony, and, doubtless, it is a drug that should always be given; one, two, or three minims of the antimonial wine every quarter of an hour, until some effect has been made upon the disease, and then at longer intervals. The best local application to the larynx is the hot sponge. A blister over the upper part of the sternum sometimes does good, and, in exceptional cases, leeches to the larynx may be used. The time all these remedies, however, require to produce their effects is too long, and their action too uncertain to allow the surgeon to depend upon them in acute cases; as accessories to the treatment they are of use, but as means of preventing death when obstruction exists and spasms are frequent, they are not to be recommended. When an operation is performed it should be tracheotomy. Laryngotomy is inapplicable and too near to the disease. Chloroform may be given without fear.

DISEASES OF THE LARYNX REQUIRING TRACHEOTOMY.

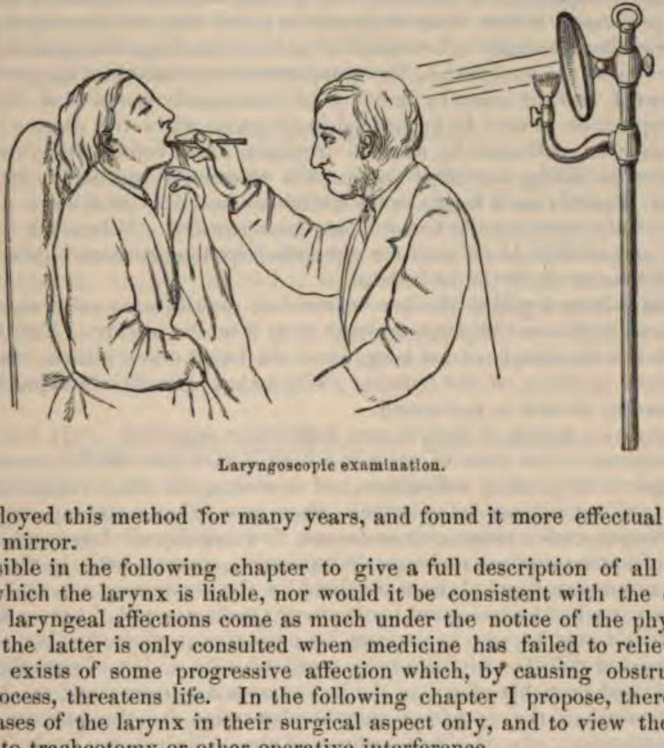
Since the introduction of the laryngoscope, our knowledge of the disease of the larynx has so much increased and the treatment of its different affections so much improved, that the subject has become somewhat extensive; so extensive, indeed, that enterprising members of our profession have contrived to turn it into a specialty. This is a subject of regret in a certain sense, as it tends to make the bulk of the profession, and with it the student, look upon laryngeal affections as difficult subjects of investigation, and beyond the reach of average skill. This is not, however, in any way correct, for the use of the laryngoscope or throat speculum is no more difficult than that of any other instrument. To use it neatly and efficiently requires skill and some practice, but the same efforts are also essential to every other surgical investigation.

The first laryngoscope was introduced to the profession in 1829 by the late Dr. B. G. Babington, who, under the term "glottiscope," invented an instrument composed of a mirror fixed to a wire handle, which, being fixed against the palate whilst the tongue was depressed, enabled him to view the upper part of the larynx. Garcia, the singer, in 1855 gave an impulse to the idea by throwing the sun's rays into the back of his mouth by means of a mirror held in his left hand; and so from a dentist's reflector introduced into his mouth he could witness the movements of his larynx in the looking-glass. But to Drs. Czermak and Turck are unquestionably due the credit of having applied this mode of investigation in a scientific way to the diagnosis of laryngeal disease. They employed, however, artificial illumination instead of solar, adopting the practice of Helmholtz in ophthalmoscopic operations.

The ordinary mode of application of the instrument is very simple. The patient sits with his back to a good light, that of the sun is the best, but a moderator or gas lamp will suffice. The lamp should be in a line with the patient's face, and on his right side; the surgeon, with the mirror fastened round his head, faces the light and reflects it on the patient. The patient is then directed to open his mouth, protrude his tongue, and hold it with a handkerchief; a warmed mirror is then introduced to the back of the fauces, while the tongue at this time is depressed. The rays of light from the frontal mirror are then made to fall upon the pharyngeal, and, with a little arrangement, the glottis and all the parts around, above or below, may be carefully examined.

The pharyngeal mirror may also be well illuminated by simply projecting the rays of light from a large reflector fastened behind a gas or moderator lamp, as seen in Fig. 313.

Fig. 313.



Laryngoscopic examination.

I have employed this method for many years, and found it more effectual than the use of the double mirror.

It is impossible in the following chapter to give a full description of all the different affections to which the larynx is liable, nor would it be consistent with the object I have in view, since laryngeal affections come as much under the notice of the physician as the surgeon, and the latter is only consulted when medicine has failed to relieve symptoms and evidence exists of some progressive affection which, by causing obstruction to the respiratory process, threatens life. In the following chapter I propose, therefore, to consider the diseases of the larynx in their surgical aspect only, and to view them simply in their relation to tracheotomy or other operative interference.

In a general way it may be asserted, that tracheotomy may be called for under any circumstances in which obstruction exists to the respiratory act, mechanical or otherwise, such as in pharyngeal affections mechanically affecting the larynx; in laryngeal disease, acute or chronic, inflammatory or otherwise; or in tumors pressing from without upon the windpipe in some part of its course. It may also be possibly required for some temporary purpose connected with operative surgery, to insure the maintenance of the respiratory act during the removal of a large pharyngeal or maxillary tumor.

Pharyngeal affections obstructing the respiration.—Abscesses about the pharynx or tonsils at times cause laryngeal obstruction, and such a complication should be treated by puncturing the abscess with a guarded bistoury. Inflammatory and ulcerating affections of the throat, more particularly those called diphtheritic, are apt to spread to the larynx and set up laryngitis. Indeed, Trousseau asserts that in most cases croup begins in the pharynx.

Tumors of the pharynx or tonsils are occasionally met with, pressing upon the larynx and interfering with its functions, or a cyst may develop at the back of the tongue behind the epiglottis, and, by its size, almost close the laryngeal orifice; or a naso-pharyngeal tumor may so press downwards as not only to threaten life by suffocation, but to cause death. In a large naso-pharyngeal tumor I had to treat, the former condition was met with, but relief was given by the removal of the growth. In another case, one of cancerous tumor of the pharynx above the soft palate occurring in a boy, æt. 18, and which rapidly recurred after its removal, death ensued from suffocation, tracheotomy having been rejected. Suffocation from simple enlargement of the tonsils I believe to be unknown, although it has occurred from cancerous disease.

Affections of the larynx requiring tracheotomy.—*Inflammatory affections* can never exist long without causing some closure of the glottis, thereby endangering life. In acute laryngitis of catarrhal origin, in membranous croup, and in diphtheritic croup, a few hours may be sufficient to produce this effect, either from œdema of the larynx, suppuration of the larynx, or the effusion of a false membrane. In all, the result is the same, mechanical closure of the glottis complicated with spasm; and in all, the important question presents itself as to whether medical treatment can be sufficient to check the disease, or surgical aid in the way of operative interference is required. Trousseau, our great authority in this matter of tracheotomy in croup, maintained strongly that the earlier the operation is performed the greater are the chances of success; that it ought to be performed before death is imminent; and that to whatever degree asphyxia may have proceeded, it ought to be tried; for in the most desperate cases there is a chance of success, provided the local lesion, the croup, constitutes the chief danger of the disease. In these views I entirely concur; they are physiologically sound and clinically correct. Indeed, the operation should be performed in all cases when the disease is steadily progressing, when it is unaffected by medical treatment, and before asphyxia, carbonæmia, or severe blood poisoning has taken place; the chances of success under these circumstances being hopeful; as it seems to be a clinical fact that in a large number of such cases the extension of disease is arrested by the operation. When the lungs, however, have become gorged with blood unfit for circulation by too protracted delay in operating, a successful issue can hardly be looked for.

In chronic laryngitis, whether tubercular, syphilitic, or otherwise, tracheotomy may be required to prevent impending death or as a means of cure. For the first indication it should not be postponed too long, for "too long" often means "too late," some spasmodic attack carrying off the patient. When these attacks consequently appear and recur, tracheotomy should be performed.

Tracheotomy as a means of cure is not sufficiently practised. "It has been hitherto generally performed in the class of cases to which I have just alluded—to rescue patients from the danger of impending suffocation, and to prolong life when threatened from laryngeal disease; and yet it must have struck most men, when watching cases which have been operated upon under these circumstances, how rapidly all laryngeal symptoms disappear and ulcerative action undergoes a reparative process, both in the pharynx and larynx, after a new passage has been obtained for the respiratory act, and complete quiescence of the parts has been secured by means of tracheotomy." I have a strong opinion, therefore, that it would be wise to perform the operation in ulcerative laryngeal affections at an earlier period than has hitherto been practised, with a view of arresting the progress of the disease, and probably of saving the larynx as a respiratory and vocal organ, anticipating the time when the operation may be demanded for the purpose of preventing impending suffocation. In the first volume of the 'Clinical Society's Transactions' I have published some cases illustrative of these views, and my more recent experience has confirmed them. It should not be performed in the very early period of the disease, whilst any reasonable hope exists that by medical or local treatment a successful result may be secured; but it should be undertaken in all cases of progressive disease, when local and general treatment have failed to make any impression on the local affection.

Tumors of the larynx are not very uncommon. Children are liable to suffer from warty growths of the rima or the surrounding parts, and in adults, epithelial tumors are likewise met with. Cancerous growths, involving the larynx, are also on record. Mr. Holmes, in his admirable work 'On Children's Disease,' informs us that out of twenty-eight cases of tumor of the larynx, which he tabulated from the 'Transactions of the Pathological Society,' seven were cancerous. He also points out the fact that, in cases of tumors of this region, life is threatened by the occasional fits of spasmodic dyspnœa, the atient being often well in the intervals, and, when these recur very severely, it becomes ecessary to perform tracheotomy.

When warty growths exist, and it is impossible to remove them from above by means f the forceps, or snare, aided by the laryngoscope, the larynx may be laid open fearlessly n the middle line and the tumor removed. I did this in 1871, in a child, æt. 3, for xtensive warty disease of the epiglottis and glottis, with complete success; and my coleagues, Mr. Durham and Mr. Davies Colley, have done the same. I have also, by the peration of tracheotomy, prolonged for many months the life of a man who had a cancerous laryngeal tumor obstructing respiration.

Tracheotomy may also be required for tumors of the neck pressing upon the larynx. I have been called upon to operate under these circumstances on three occasions; also for intrathoracic tumors, aneurismal or otherwise, the operation in both cases being demanded for sudden laryngeal spasm, due either to pressure on the recurrent laryngeal nerve, or to compression of the trachea, Dr. Bristowe having well shown ('St. Thomas's Hosp. Rep.,' vol. iii, 1872) "that destruction of the functional activity of one recurrent laryngeal nerve is marked by paralysis of the corresponding vocal cord, which can be recognized by means of the laryngoscope, by impairment of the musical quality of the voice, and (probably) by some difficulty of swallowing, owing to the tendency of food to slip into the larynx, but it is not necessarily attended with stridor or dyspnœa; and, in the second place, that compression of the trachea involves stridor and difficulty of breathing, which is often paroxysmal and liable to end in sudden death, but that it does not of itself interfere with perfect intonation, excepting only in so far as it may render the voice weak by diminishing the supply of wind to the vocal organs."

Excision of the Larynx.

This operation was first performed by Billroth, of Vienna, in 1873, for cancerous disease in a man; and Heine, of Prague, Moriz Schmidt, of Frankfort-on-the-Maine, and Langenbeck, of Berlin, have followed his practice, but the success that has attended it is not such as to lead me to recommend the operation. The operation can be performed by making a transverse incision parallel to and above the hyoid bone, and a vertical one at a right angle to it over the larynx, the dissection of the larynx being made from above. Dr. Foulis, of Glasgow, has, however, recently performed this operation upon a man, æt. 28, for recurrent papillary sarcoma, with singular success. In the operation he left the epiglottis. ('Lancet,' 1877, vol. ii, and 1878, vol. i.)

Bronchotomy, Tracheotomy, Laryngotomy.

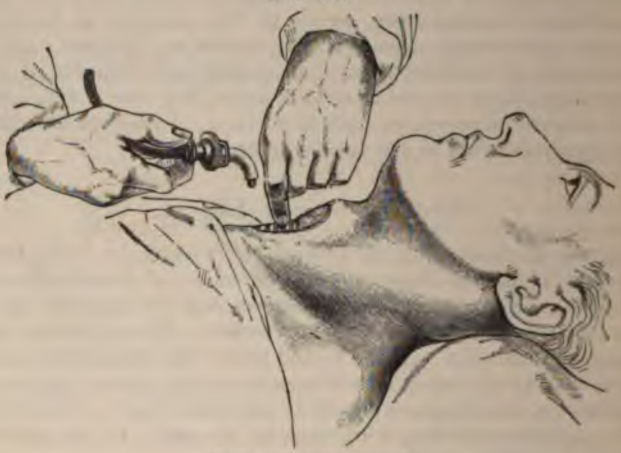
Any opening made by the surgeon into the windpipe is called "*bronchotomy;*" when between the thyroid and cricoid cartilages, it is called "*laryngotomy;*" when below the cricoid into the trachea, "*tracheotomy;*" and when the incision includes the cricoid cartilage and upper rings of the trachea, it is called *laryngo-tracheotomy.* In all these operations the objects are the same, either to admit air into the lungs when some obstruction exists in or above the larynx, or to facilitate the removal of a foreign body or morbid growth. Dismissing the general term "bronchotomy" from our consideration, the two latter operations claim our notice, and are applicable in two different classes of cases. When the cause of obstruction is *above* the larynx, laryngotomy may be performed; when in the larynx, tracheotomy or laryngo-tracheotomy should always be preferred. For the removal of a foreign body or new growth, tracheotomy is the better operation, the incision at times being extended upwards into the larynx, either through the cricoid and thyroid cartilages or downwards as far as needed. For both operations chloroform may be safely administered, unless asphyxia be profound, when it is not required.

Laryngotomy is not an operation to be performed on children, the crico-thyroid space at an early period of life being too small to allow of a free opening being made into it. It is only applicable in adults when obstruction to respiration exists above the rima glottidis, such as that caused by an impacted mass of food, or some pharyngeal growth. For tetanus or any other spasmodic affection of the larynx threatening life, it may likewise be employed, as well as in operations on the palate, pharynx, &c., in which it is advisable to insure the free passage of air into the lungs during manipulation; although under these latter circumstances tracheotomy and the use of Dr. Trendelenburg's plug is to be preferred (Fig. 205).

To perform the operation, the patient should be placed on the back with the thorax raised, shoulders drawn down, and head extended. The operator should stand o patient's right side, and feel for the thyroid cartilage, at the lower border of whi windpipe is to be opened. To do this, a vertical incision is to be made in the m line, about one inch long, cutting through all the tissues covering in the crico-th membrane. The membrane should then be opened transversely with a knife. The thyroid arteries cross this space, and may possibly be divided giving rise to some hemorrhage. Sir W. Fergusson has recorded a case narrated to him by Professor T of Edinburgh, in which a fatal hemorrhage occurred from these vessels.

Tracheotomy is by no means a simple operation, but under all circumsta delicate, requiring coolness and caution, and when performed hurriedly, is too often difficult and even dangerous. In very young children it is always troublesome. surgeon may at times be called upon to be rapid in his movements, but never sho hurried. As the result of hurry many are the mistakes that might be enumerate as wounding of the innominate or carotid artery; the opening of the œsophagus t the trachea; the puncturing of the spine through both these tubes, &c.

FIG. 314.



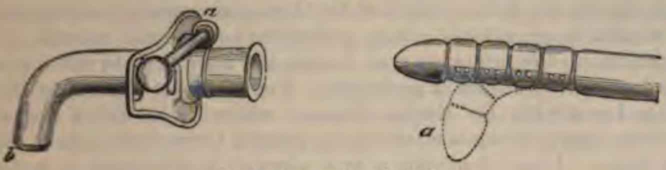
Operation of tracheotomy.

The patient should be placed as in laryngotomy, while the surgeon stands on t side. The different points in the neck must then be made out, and the existence large vein in the line of incision looked for, and, if present, avoided. The best for opening the trachea is half an inch below the cricoid cartilage or below the ist the thyroid gland; but this is not a point of so much importance as some surgeon lead us to suppose. In infants it may be disregarded. An incision about two inc may then be made through all the soft parts covering the trachea. This may rapidly when needed, deliberately when possible, care being taken at the same means of retractors, not to displace the parts. During this step of the opera surgeon's left index-finger should be his guide; and it should be steadily kept trachea till the rings are felt, while it will also intimate the presence of any arte the tube or in the line of incision. The rings once recognized, the trachea may b with the knife, its edge being turned upwards, and the opening made parallel nail of the left index-finger, which is in the wound. When the windpipe has been air, blood, and mucus will at once bubble up. The canula with its pilot should introduced into the trachea through the opening which the left index-finger has this finger acting all through as a guide and director, and, lastly, as a plug to th till the canula has been introduced. The eye of the operator should be direct end of his left index-finger.

In opening the trachea, some prefer to use the hook to draw it forward, and in which much bleeding exists, or the trachea is very deep, it may be employed. however, rarely used it, having more confidence in the use of the left index-fin guide throughout.

Some employ also a dilator to keep the wound open till the tube is introduce others prefer to open the trachea with a sharp trocar. The former practice is sary, and the latter dangerous; as a sharp trocar may perforate the trachea a nd enter the œsophagus, an accident I have known to occur, or if it slip by the side of he windpipe the large vessels will be endangered. With respect to the canula, Fuller's i-valve has hitherto met with general approval, and Durham's "lobster-tail" canula Fig. 315) has been much liked; though the best by far is the ball-and-socket instrument

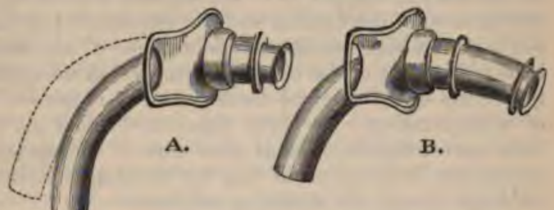
FIG. 315.



Durham's canula and pilot.

(Fig. 316) I had made some years ago—its great advantage consisting in the mobility of the tube with the trachea, the neck plate being fixed. The rigid tube when required to be worn for long, too often excites ulceration by the pressure of its free end on the trachea, which may extend into the innominate artery. Mr. Morant Baker has recently introduced into practice a tube made of vulcanized red india-rubber, which seems to answer well, and may be employed on the second or third day after the operation has been performed. Every metal canula should be double, and every canula fixed in position by a piece of silk or tape passed through the shield and fastened round the nape of the neck. After the operation, the atmosphere of the room should be kept warm and moist by the admission of steam, care being taken that the air is not saturated with vapor. The wound ought to be kept clean; strapping and sutures are rarely required; water dressing or sweet oil being probably the best local applications. Great care should be observed to keep the orifice of the canula free from mucus and the inner tube clean. A piece of muslin should be placed over the tube to prevent the entrance of foreign bodies.

FIG. 316.



Bryant's canula. A. Full length. B. Shortened.

Complications.—If the operation should be complicated by hemorrhage the surgeon must not be alarmed. When arterial, it must be arrested before the trachea is opened, either by the application of a ligature or by torsion; if venous, the sooner the trachea is opened the better, for a few good inspirations do more to relieve the venous congestion, which is almost always present when tracheotomy is demanded, than any other attempt to check bleeding. As soon as the tube has been introduced, the patient may be rolled over on his side, to allow the blood to run away from the tracheal wound. A piece of sponge applied with some pressure over the wound is generally enough to arrest all venous bleeding, unless some large venous trunk has been opened. I have never known hemorrhage of this kind to be so copious as to interfere with the operation, or to be so persistent as not to cease readily on its completion. If the surgeon stops his operation till bleeding has ceased, he will too often wait till the necessity of the operation with the life of his patient has passed away.

Opening of the trachea.—There can be little doubt, that in patients after puberty, the trachea should generally be opened below the isthmus of the thyroid gland, but in infants and young children where the trachea is deeply placed and the neck fat and short, the nearer the opening is to the cricoid cartilage the better. For several years I have been in the habit of opening the trachea immediately below the cricoid ring, and never have hesitated to divide the latter when more room is required. In many instances, I have gone through the isthmus of the thyroid, and never had any reason to regret it; nay, I am almost tempted to believe that the dangers of its division are really theoretical and practically may be disregarded. Of this I am convinced, that the nearer the tracheal opening is to the lower border of the cricoid ring, the better is the operation. If the opening be too small at the first puncture, a second should be made rather than grope about with retractors and instruments to find the original opening. The tracheal tube need not be very large, for Mr. Marsh has demonstrated ('St. Barth. Hosp. Report,' vol. iii) that while the cricoid cartilage is the smallest part of the air-tube, the rima glottidis is smaller.

Under all circumstances, the operation should be completed, and, even in apparently hopeless cases, artificial respiration should be kept up through the wound. Mr. Holmes has recorded a case of Mr. Tatum's in which it was maintained for two hours with ultimate success.

When tracheotomy has been performed for thyroidal tumors pressing upon the trachea, the surgeon should have at hand a long perforated tube, small enough to be introduced through the canula, as the tumor may so overlap the trachea as to cause obstruction below the point at which the operation is performed. For the want of such an instrument, I lost a patient whom I saw with Dr. Risdon Bennett, while by its aid, I was enabled to save another for several days, the elastic tube being pressed through the canula, past the obstruction, into the lungs. I have had such a tube adapted to my canula as a pilot to introduce it. It is almost needless to say, that the canula should be removed from the trachea as soon as respiration has been re-established by the natural passage, and that it should on no account be left in more than three months. When required longer, a new one should be substituted, since the canula rapidly undergoes oxidation in the trachea and becomes liable to break. In a patient of my own, where the tube had been worn six months, half its circumference close to the neck shield had been destroyed, and the slightest violence would have broken the instrument in the trachea. The vulcanite canula is good for constant use.

Mr. T. Smith, in an excellent paper ('Med.-Chir. Trans.,' 1865) has given a good summary of the obstacles to the re-establishment of natural respiration after tracheotomy, and he has shown, that the chief causes are a narrowing of the passage of the larynx by granulations around the canula, and the impairment or loss of those functions of the muscles of the larynx which regulate the admission of air through the rima. There may, likewise, be a persistence of the original cause which necessitated the performance of the operation, the effects of the original disease, or the closure of the vocal cords from the cicatrization of old ulceration. In three cases now under my observation in which tracheotomy has been performed for chronic ulceration of the larynx, the rima has so contracted as to be impervious in two, and in one, the opening is so small as to be insufficient for respiration, although enough for speaking purposes.

To help the surgeon to judge of the patency of the glottis, Luer has invented a bullet valve to be adapted to the orifice of the canula; and Mr. T. Smith an india-rubber one which seems equally efficient, and is a simpler instrument. Either may be employed, as anything that helps to decide when the canula may be removed with safety is of value.

CHAPTER XIX.

SURGERY OF THE CHEST.

CONTUSIONS.

THE chest is liable to be contused, and severe contusions are not unfrequently followed by extensive effusions of blood. The swelling under these circumstances occurs suddenly after the injury, and appears with the discoloration of a bruise. These cases, as a rule, do well if left alone, the extravasated blood becoming absorbed, but, in exceptional examples, the blood may break down and give rise to suppuration.

TREATMENT.—When the contusion is slight, the application of a cold lead lotion is all that is necessary, and in more severe examples where extravasation is great, there is nothing equal to the application of a bag of ice. In obstinate cases, the use of some stimulating liniment hastens recovery, and the administration of tonics is always of value.

When the effused blood breaks down and suppuration ensues, the abscess must be opened, but the surgeon need be in no hurry to conclude that the effused blood is incapable of being absorbed nor that pus has formed, since it is a familiar fact that blood may remain fluid in the tissues for a long period and yet be eventually removed by absorption.

Rupture of the Pectoral Muscle

an accident which may take place from a forcible strain applied to the muscle unprepared for action or from external violence. I have seen a case in which the muscle was nearly torn across about its centre, from the forcible drawing back of the arm, in which the fingers could be inserted between the divided ends of the torn muscle, and there was much effusion of blood. In it the arm was bound to the side by a bandage and ice locally applied, and three months subsequently, some power existed in the muscle. The amount of repair which is to be expected in these cases depends upon the severity of the injury, and the care with which the parts are kept in position during its progress. As a general rule, the two ends of the divided muscle should be kept in contact for at least two months before movement is allowed. This accident is not rare in children from forcible dragging of the arm.

Fractured Ribs

form about a tenth part of the cases of fracture admitted into a large hospital. This accident is less common in children and young adults than in subjects past middle age, on account of the elasticity of the ribs. In the aged the ribs become so brittle that they break under slight external violence, and in rare cases from the violence of a cough. I have seen this occur in two patients, the one a male and the other a female, between sixty and seventy years of age, in whom no signs of disease existed, and both are now alive.

Fractured ribs are not uncommon accidents in lunatic asylums, and generally arise from direct violence; though it would be wrong to assume that they are always the result of ill-treatment, as patients when much excited, will inflict unconsciously most serious injuries on themselves, and it has been proved that the bones of many of the insane are in an abnormally brittle state. This is especially true in the disease known as "general paralysis of the insane." Dr. Campbell Brown, of Liverpool, has analyzed the ribs of general paralytics, and states that "the ratio of organic constituents to earthy matters is much greater, while the ratio of lime to phosphoric acid is distinctly less, in the ribs of paralytics than in those of healthy adults. There are the same differences between the composition of healthy ribs and those of paralytics as between the composition of the adult large bones and those of the fœtus. And generally the composition in cases of paralysis approaches that observed in cases of osteo-malacia." Some striking cases bearing on this subject are recorded by Dr. Hearder in the 'Journ. of Mental Sci.' for 1871.

In the majority of cases, the injury being the result of *direct* violence, the fracture takes place at the part struck, and so the ribs are often driven in. In the minority, where it is due to *indirect* violence such as that caused by a crush or squeeze, the ribs generally give way about their middle, and three or more become injured, both sides being not unfrequently involved. When the bones are merely broken, it is called a *simple* fracture; but when complicated with a wound communicating with the fracture, *compound*. When the ends of the broken ribs are driven inwards, the pleura costalis or the lung itself may be torn, and the heart or pericardium or abdominal viscera injured. In an analysis of 136 consecutive cases which I made when registrar at Guy's, 108 were uncomplicated and twenty-eight complicated fractures, six of which died at once from fatal collapse. Of the former, eight only had secondary inflammation, whilst of the latter, sixteen were complicated with emphysema, three with emphysema and hæmoptysis, and three with extensive injury to the lung and secondary inflammatory symptoms. All these recovered, except two that died from old-standing disease.

When a rib is broken, the serous lining of the chest, the pleura costalis, is probably injured, and the danger of the accident lies in the secondary inflammation—pleuritis—which may follow; and this occurred in eight of the 108 cases just alluded to. When the lung is injured, as indicated by emphysema or hæmoptysis, pneumonia, which happens in about seven out of every twenty-two cases, is the danger to be feared. Cases that die from fatal collapse *after* the accident generally do so from hemorrhage due to external laceration of the thoracic or abdominal viscera. In gunshot fractures, a portion of the ribs may be detached and driven into the lung.

Simple fracture is a serious accident only in subjects who are the victims of some chronic chest affection, when, from the broken ribs rendering it impossible for the patients to expectorate, asphyxia is favored.

Fractures complicated with injury to the lung are, however, more serious. When severe, they are *directly* dangerous from the shock to the system and the hemorrhage that frequently attends them; and *indirectly* so from the fact that the slightest lung wound is liable to be followed by inflammation of the lung itself or of the pleura.

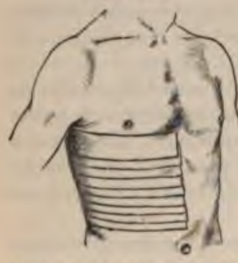
Fractured ribs generelly unite in about a month; and where they have not been kept quiet, considerable callus may be thrown out, or a false joint formed.

Diagnosis.—Pain at the seat of injury, associated with a peculiar catch in the breath of the patient and the general avoidance of anything like a full inspiration, are somewhat characteristic symptoms of a fractured rib, more especially when they show themselves at once after direct or indirect violence. At times, too, the patient will complain of a grating in the part, and, on the application of the hand over the seat of injury, if the patient be made to cough, crepitus will be felt—this crepitus being caused by the friction of the ends of the broken bone. When the seat of fracture is beneath a thick layer of muscles or fat, this symptom may, however, escape detection; nor should it be too closely sought after when others indicate the nature of the injury, as the manipulation required to elicit this sign is sometimes considerable, and any approach to violence or over-manipulation is always injurious.

When **emphysema** complicates the case as indicated by a more or less diffused puffy swelling which crackles on pressure, there will be no doubt as to the lung having been injured, since this symptom is caused by the escape of air from the lung into the cellular tissue about the seat of fracture. This may be either local or general; when associated with *hæmoptysis*, it is fair to infer that the lung has been penetrated; the severity of the mischief being gauged by the extent of the emphysema and the amount of the hæmoptysis.

TREATMENT.—The object of the surgeon in the treatment of a simple fracture of the thorax is, to maintain the ribs at rest, which should be effected by the application of strips of strong adhesive plaster two inches broad, extending from the sternum to the spine, and from at least three inches above to three inches below the seat of injury, each strip being applied so as to cover half of that which preceded it (Fig. 317). By this method, the movements of the broken ribs are restrained without those of the opposite side being interfered with. It is, moreover, both in comfort and efficiency, far superior to the old method of encircling the chest with a flannel roller; indeed, it generally affords speedy relief to all symptoms. When the case is complicated with emphysema or even hæmoptysis the same treatment should be carried out, for in these more severe cases the necessity of maintaining the immobility of the ribs is just as necessary as in the less severe.

FIG. 317.



Strapping in fracture of ribs.

In rare cases in which much displacement has occurred, a sheet of felt or gutta percha made soft by hot water and moulded to the part is of great value, the mould being subsequently fixed by strapping as described.

The patient should be kept quiet, though not necessarily in bed, and abundance of bland, nutritious, but unstimulating food given, with sedatives, if required; of the latter chloral in half-drachm doses is probably the best, though morphia or Dover's powder is also good. When cough or any symptoms of inflammation of the pleura or lungs appear, antimonial wine in doses of thirty minims for an adult every four or six hours in some saline mixture, is a most valuable remedy. When chest complications are severe, and orthopnœa with a sense of suffocation from pulmonary congestion threatens life, venesection should be practised. Local treatment was sufficient in 100 of the 136 cases above mentioned.

In a case of severe injury to the chest, caused by the passage over it of the wheels of a heavily laden cart, that came under my care some time ago, fracture of five or six ribs and dislocation of the clavicle occurred, associated with collapse, intense dyspnœa, and hæmoptysis; I bled the patient twice in twelve hours, and each time with immediate relief, the case going on to a good recovery. In it the severe dyspnœa and venous congestion, the rapid and hard pulse that came on as soon as the collapse of the accident had passed away and the circulation had been restored, too surely pointed to an excessive engorgement of the lungs, and so if relief were not afforded, absolute suffocation would speedily ensue by the patient's own highly carbonized blood. At such a crisis, antimony, however beneficial in simpler cases, could not be trusted, as there was no time for it to take effect. Under these circumstances bleeding was performed, and, as the blood flowed, life seemed gradually to return; the laborious breathing became quiet and subdued; the deadened and congested eye, bright and natural; the pulse from being full and hard, softer and less bounding; and the boy's feelings, released from the impression that death was nigh at hand, became more hopeful and resigned; and, as a spectator, I felt such a hope was valid, and that success might crown our efforts. After the lapse of twelve hours, however, the symptoms returned, and the repetition of the bleeding was followed by a repetition of all its benefits. The antimony then came in to complete the cure; by the double venesection, the pulmonary vessels had been relieved of their congestion, while the antimony, in acting upon the circulation, perfected the cure by preventing a return of the former threatening symptoms. The benefits arising from the treatment adopted in this case have such a lasting hold on my memory that I cannot too strongly recommend the practice thus pursued, and the more so, as I have seen it equally successful in other cases.

Bleeding is now rarely performed; and at Guy's Hospital I believe it is rarer than any capital operation. In the case of lacerated lung, however, when urgent dyspnœa makes its appearance and the powers of the patient do not forbid it, I know of nothing which gives greater relief to the patient or greater pleasure to the practitioner. Bleed with no sparing hand; letting it flow freely in a full stream, and as it flows, the symptoms will gradually disappear. When relief has been obtained, arrest the flow immediately, as syncope can only do harm. The aim should be to make an impression through the systemic circulation upon the pulmonary. The patient should be carefully watched, and the operation repeated if the symptoms return, and, if necessary, even for a third time. The antimonial treatment, however, must not be neglected. The object of the bleeding is to relieve immediate symptoms and to give time for the antimony to take effect, because when the patient has been brought fully under its influence, all danger may be said to have disappeared; few patients die from secondary inflammation of the lungs when once fairly under the influence of antimony.

Fracture of the sterno-costal cartilages is a rare accident. I have seen but two cases, and in one of the seventh rib, which had resulted from a direct blow, a false joint existed. These which are said to unite generally by bone can be treated in the same way as fractured ribs.

Dislocation and fracture of the sternum are likewise rare accidents, and the majority of them are complicated with other injuries, such as those of the head and spine —this condition having been found in four out of fifty-six fatal cases of injury to the spine at Guy's Hospital probably from the violent descent of the chin against the manubrium. It is occasionally met with also as a complication of fractured ribs. When fracture takes place, it is generally transverse and oblique from before backwards, the lower fragment being found projecting, only rare examples existing of a vertical fissure. When the upper portion of bone is displaced, it is generally displaced backwards; Rivington, in an able paper ('Med.-Chir. Trans.,' 1874), has fairly shown that displacement occurs in preference to fracture when an arthroidal joint exists between the manubrium and gladiolus. When deformity is present from displacement of bones, the diagnosis is easy, and when this does not exist, pain in the part, aggravated by a full inspiration and crepitus on the application of the hand are the chief symptoms. The *treatment* must be the same as for fractured ribs, such as the recumbent position and strapping over the part, complications being dealt with as they arise.

Dislocation of the ribs requires notice, although little can be said about the subject. It is rarely if ever an accident *per se*, and when it occurs, it is part of a more severe one, such as fracture of the spine, or complicated fracture of the ribs. The same remarks apply to dislocation of the *ribs from the cartilages*, and the *cartilages from the sternum*. Practically all these cases should be dealt with like fractures.

WOUNDS OF THE CHEST.

The main point to be determined in such cases as these is, whether the wound is superficial or has penetrated the pleura; for if the former obtains, slight cause for anxiety exists, but if the latter, the accident is grave.

When the wound is *penetrating*, the extent of the penetration and the organ penetrated has to be determined. Is the pleura alone wounded—a rare injury—or is the lung involved? Is the heart injured, or any of the great vessels—the intercostal or internal mammary artery? Many of these points can only be determined by a knowledge of the kind of weapon employed, its subsequent appearance, the direction of the force, and the anatomical knowledge of the surgeon; and, even then the difficulties of these cases are often great, as witnessed in a recent memorable trial (Flora Davy). When emphysema and hæmoptysis are present, they may be accepted as clear indications of a wounded lung. Emphysema alone is always a suspicious symptom, though it may occur to a limited extent in non-penetrating punctured wounds that transverse the soft tissues outside the thorax; while the absence of hæmoptysis is no proof that the lung has escaped injury. When blood and air bubble through the wound and air passes freely from it, or a portion of lung protrudes, there is no room for doubt as to the nature of the injury; but these cases are exceptional. In the majority, the diagnosis is ever uncertain, since there are no definite individual symptoms by which injury to the lung is to be diagnosed. The surgeon in his anxiety to make out the point must never be induced to probe the wound, or to explore it with a finger; nor should he test the condition of the lung by making his patient cough to expel air through the thoracic opening. Indeed, he should throw aside all direct or manipulative modes of investigation, and trust to the indirect.

The *direct* effects of a penetrating wound are, hemorrhage into the chest or hæmothorax, emphysema, pneumo-thorax, and hernia of the lung. The *secondary* results are those of inflammation such as pleurisy or pneumonia, hydro-thorax, or empyema, with their consequences.

The *prognosis* is always unfavorable, and should be guarded, more particularly when the wound is penetrating; but, when a week has passed without any unfavorable symptoms appearing, a more promising and decided tone may be assumed.

TREATMENT.—In all suspected or obvious penetrating chest wounds, the utmost gentleness should be employed, and complete quiet enforced; as any deviation from this practice may disturb nature's reparative process, disarrange clot, and excite over-action or inflammation. The external wound should be carefully *cleaned and closed*, and all foreign bodies removed. The patient should be placed in the recumbent position, and on no account allowed to stir. He should be fed on the simplest nutritious food, and which for the first two or three days should be cold, while ice and milk is without doubt the best mixture. The collapse which often follows the injury need not excite alarm unless it be protracted or severe, for when the result of hemorrhage it is not only a salutary measure, but the only means the surgeon looks to for the arrest of hemorrhage, as he himself is powerless to interfere. If blood, however, accumulates in the chest and by its mechanical pressure threaten life, some means must be found for its evacuation, either through the original wound or by the operation of tapping, or by an incision of the thorax. The indications should be very decided before the surgeon interferes, as the extravasated blood rapidly coagulates and consequently is difficult to remove. The same remarks hold good when air accumulates or is pent up in the pleural cavity.

The symptoms that attend reaction should be carefully watched, and anything like excess of action, as indicated by increased difficulty in respiration, cough, or a rapid pulse, ought to be met by the administration of antimony in half-drachm doses of the wine with some saline every three or four hours.

If the lungs become gorged with blood and asphyxia threatens, venesection is as valuable a remedy in these cases as it has been shown to be in those of fractured ribs. Dr. Macleod tells us, that in the Crimea, the cases of gunshot wounds of the chest that did the best were those in which early and repeated bleedings were had recourse to. Pain must be relieved by anodynes, chloral being better than opium.

Hernia of the lung or pneumocele is a rare consequence of a punctured wound of the thorax. I have seen but one example where the tumor was on the left side, external to the nipple, and about the size of a walnut. The mass was left *in sitû* and gradually withered. When the hernia is recent, however, and the lung healthy, its reduction is generally considered to be the best practice, but when of long standing and diseased it had better be left alone. Its removal by ligature or the knife has likewise been recommended, successful cases having been recorded of all forms of practice. In a case which came under my care at Guy's in 1876, of fracture of the sternal ends of the left third and fourth ribs, by the man falling upon the blunt end of some wooden palings, in which the bones were driven in without wounding the integuments, a hernia of the lung took place the size of a duck's egg, but an excellent recovery followed the reduction of the hernia and the persistent application of pressure. Velpeau has recorded an instance of hernia of the lung following the healing of a wound. The tumor in such a case is covered with integument, and is called the consecutive variety of hernia. In such a case, all that can be done, is to protect the lung from injury by a shield.

Laceration of the lung without fracture of the ribs is an accident of occasional occurrence, and I have recorded an instance in 'Guy's Reports' for 1860, arising from extreme pressure upon the elastic ribs of a boy, æt. 7. Poland also, in his excellent article on the chest in 'Holmes's Surgery,' has quoted several others. M. Gosselin's explanation of its cause is probably correct, viz., "that at the time of the injury, when the chest sustains the violence, the lungs are suddenly filled and distended with air by a full inspiration, and the air, prevented from escaping by occlusion of the larynx, thus becomes pent up in the lung tissue, and the lung, not being able to recede from the superincumbent pressure, its tissue necessarily gives way." The symptoms of this injury are much the same as have been mentioned in the paragraph on wounds of the lung, while the treatment must be similar.

Severe compression of the chest may likewise cause laceration of the heart or large vessels; also brain symptoms such as unconsciousness, epistaxis, and hemorrhage into the orbit beneath the conjunctiva and eyelids; and, in a singular case which I recorded in the same volume of the 'Guy's Rep.' as that of the boy just quoted, paralysis of the muscles of deglutition and of the larynx, which lasted for two days.

Abscesses are frequently found about the chest, and when situated beneath the pectoral muscles are very obstinate. They may be confined to the cellular tissue of the part and connected with the subpectoral glands, or associated with ruptured muscle or inflammation of the periosteum or bone.

When connected with the muscles, they must be opened and the parts kept quiet by binding the arm to which the muscle belongs to the side, as each movement of the muscle retards recovery.

When due to *periostitis* or *ostitis*, they are frequently spyhilitic, and are more commonly situated over the sternum, though any of the ribs may be affected. Under these circumstances, constitutional treatment is essential, and the iodide of potassium in gradually increasing doses from five to ten grains in some tonic, such as bark, is the best medicine. If the bone dies (necrosis) the dead portion must be removed when nature proves herself incompetent to throw off the *sequestrum*.

When sinuses exist about the thorax, the surgeon should always be alive to the fact that they may be due either to an *empyema* which has naturally discharged itself, or to a *substernal abscess* which is making its way through the intercostal spaces. The history of the case will be found to be the only correct clue to the diagnosis. In both instances, a free opening into the abscess and the washing out of its cavity is required.

Tumors of the chest are not uncommon, but come more under the notice of the physician. Malignant and other tumors, however, may arise external to the ribs, and I have seen several cases of exostosis from the ribs and one of enchondroma. No surgical interference was called for. Exostosis from the first rib may press upon the branches of the brachial plexus and give rise to some pain, or upon the subclavian artery or vein and produce obstruction.

Deformities of the chest are mostly due to spinal curvatures, though the contracted or compressed thorax with the projecting sternum of childhood (pigeon breast) is frequently found where some long-continued obstruction to natural respiration exists. This is not, however, permanent in a large number of cases, since children who are the subjects of it "grow out" of the deformity as their general condition improves and powers strengthen. It is commonly found in rickety subjects, and is thought by some to be the result of enlarged tonsils. It is probable, however, that the enlarged tonsils and deformity are accidental associates.

Deformity of the chest may be due to an old pleurisy.

TAPPING THE CHEST.

When air accumulates in the chest (*pneumo-thorax*) either as a consequence of disease or accident, causes pressure on the lung and interferes with the respiratory process so as to create alarm, the tapping of the chest (paracentesis thoracis) with a small trocar and canula fitted with a valve, may be called for. When blood accumulates (*hæmo-thorax*) producing similar alarming symptoms, and the blood is mixed with air, and it is clear that life will be extinguished if relief be not afforded, it must be let out; and for this purpose it is probably the best operation to make an incision into the thorax where no wound previously existed, or to enlarge a small one when present; but to do this with a trocar and canula is always a difficult and often an impossible task on account of the coagulum. When *serum* presses upon the thoracic contents (*hydro-thorax*) and requires surgical interference, the trocar and canula with the aspirator are beyond doubt the best instrument to employ, great care being observed to exclude air. The object, under all these circumstances, is to remove the pressure from the lung in the most effectual way by the with-

35

drawal of the compressing material. When pus exists (*empyema*) surgeons are not quite decided as to the best means to be employed, although all are agreed as to the propriety of drawing off the pus. To do this by means of the aspirator or the trocar and canula gives temporary relief, but does not cure the disease, for which more efficient measures are required. For my own part I believe that when pus so presses upon the lungs and interferes with the respiratory process as to call for surgical interference, the pus must be let out, by means of a free opening, the opening being large enough to permit of the free escape of all fluid, and the ingress and egress of all air, for the admission and retention of air in a suppurating cavity will almost certainly end in decomposition. The introduction of drainage-tubes by M. Chassaignac has consequently been of great service in the treatment of empyema. Dr. Goodfellow and Mr. De Morgan have been their chief advocates in this country, the latter surgeon passing the perforated india-rubber tube through the canula upon a long iron probe, and bringing it out of a second opening in the lower and posterior part of the chest, this second opening being made with a scalpel upon the extremity of the probe pressed against the lower intercostal space. The perforated tube consequently passes as a seton through the chest and allows the free escape of any fluid in its cavity. This operation, however, has its dangers. My friend Dr. Sutton informed me of a case in which it was performed for empyema and pneumothorax, and, a few days after, emphysema appeared about the wound, which spread over the whole body and destroyed life.

I have never adopted this practice in the way here detailed, being satisfied with a free opening into the thorax, either with a scalpel or large trocar and canula, and the subsequent introduction of a drainage-tube or elastic catheter into the thorax, either through the canula or otherwise, and the subsequent daily washing out of the cavity with a solution of iodine; or, subaqueous drainage may be employed. In May, 1875, I followed the former practice in the case of a gentleman, æt. 37, whom I saw with Dr. Rowlands, of Carmarthen, and drew off three quarts of pus from his left chest through a free opening, and subsequently passed a drainage-tube into the cavity. In three months, convalescence ensued, and in another month he was quite well, the lung on the affected side having expanded. Indeed, I quite coincide with Dr. Goodhart ('Guy's Hosp. Rep.,' 1877), that "if drainage is decided upon nothing short of perfect drainage is safe for the patient;" and to this end the opening into the thorax must be free, and the cavity of the chest kept well emptied either by irrigation or by what has been described as subaqueous drainage, which should be carried out as follows:—"Having determined on the spot at which puncture of the chest is to be made, a trocar and canula are taken, the bore of which is about five millimetres. A length of several feet of black or red india-rubber tubing, which will slip easily through the canula, is placed ready at hand; the chest is then tapped and the trocar withdrawn, and as the fluid comes in full stream by the canula, the india-rubber tubing is pushed along the latter into the chest as far as necessary—usually four or five inches. The canula is then withdrawn over the tube, leaving the one end of the latter in the chest, while the other or free end is kept under water by the side of the bed. The tube then acts as a syphon."

This plan of drainage is not, however, very complete, for out of 30 cases in which it was employed, as reported by Dr. Goodhart, in 18 imperfect drainage had to be recorded; and as this is a method which professes to drain away pus, it cannot be said to have proved successful.

In young people where the ribs are elastic, good results may be looked for; but in the old, where the ribs are rigid, no contraction can be expected.

THE OPERATION.

In tapping the chest the following points should be observed—The ninth intercostal space should be chosen just in front of the angle, or the seventh midway between the sternum and the spine. This latter spot can always readily be found by drawing a line with a string round the body on the level of the nipple, and midway between the sternum and spine, this line will cut the proper intercostal space. At this spot close to the lower rib, a small incision should be made through the skin and fascia with a lancet or scalpel, and through this the trocar and canula, warmed and oiled, should be introduced; the trocar as soon as it has perforated the chest should be withdrawn, the canula being pushed more home. When the operation has been performed for air or serum, a small instrument should be employed, and great care used to prevent the admission of air. For this purpose there is no better instrument than the pneumatic aspirator of Dr. Dieulafoy, or one of its modifications, and Dr. Bowditch, of Boston, United States, a staunch supporter of this practice, reports ('Practitioner,' April, 1873) that during twenty-four years, and in 270 operations, he had never seen any injury done by the aspirator. As a substitute, one of the canulas may be used fitted with a stopcock or valve to prevent the admission of air.

When the chest requires opening for the discharge of blood or pus, it has been already asserted that a free incision or a large canula should be resorted to. I prefer an incision, and make it large enough to admit my little finger, and subsequently, a large india-rubber drainage-tube. Trousseau strongly advises the operation of tapping when serous effusion fills the cavity, as indicated by auscultation and percussion; when oppression of breathing also exists, it may be urgently needed, but this oppression, adds he, is one of the most deceitful of signs, and its absence ought not to inspire too great a feeling of security; as by refraining from interference we run the risk of losing patients, when the operation would assuredly have saved. In **empyema** he fixes in the canula and draws off the fluid every twenty-four hours, injecting the chest with a solution of iodine, one part of the tincture in six, every two, three, or four days.

It should, however, be recorded that sudden death has taken place after thoracentesis for pleuritic effusion or empyema, although evidence is wanting to prove that any distinct relation exists between the operation and death, since cases are on record in which sudden death ensued in the normal course of cases of pleuritic effusion. Trousseau has recorded examples of the latter kind, and Drs. Cayley and Broadbent of the former. ('Clin. Society,' 1877.)

APNŒA, OR SO-CALLED ASPHYXIA.

Death from asphyxia, in the common acceptation of the term, means death from either the cessation of the respiratory process or the want of the ordinary respiratory medium (oxygen), the heart ceasing to act after the cessation of the respiratory process. Etymologically it means an absence of pulse. The more correct term is apnœa. It is caused by whatever interferes with the admission of air into the lung, by such acts as *drowning* or *hanging;* by diseases that mechanically block up the air-passages, or excite spasm of the larynx; by any external or internal condition of the thorax that prevents the admission of air into its cavity or interferes with its expansion; by the want of the respiratory medium or by the inhalation of toxic vapors.

Under some circumstances, the asphyxia is rapid or acute, in others, chronic. In accidental cases, it is chiefly the former; in disease, the latter. In both, however, the result is the same, the blood not being decarbonized as it should be, and what Dr. Cleveland has rightly called carbonæmia ensues. Special symptoms may depend entirely upon the nature of the asphyxiating cause, but the ultimate effects are the same in each. In all, whether slow or rapid, there is congestion and lividity of the face. In all, the heart continues to beat, though laboriously, after respiration has ceased, the action becoming gradually less distinct till it stops altogether. It is possible for the heart to continue its action from two to four minutes after the last respiratory effort.

After death, it has generally been thought, the *cerebral vessels* would be found gorged with blood. Ackeman has shown, however, that this condition is present only when the head of the subject has been kept lower than the rest of the body, and that death by suffocation is always connected with an exsanguine state of the cerebral vessels. The *right side of the heart and great vessels* will be full of black blood, whilst the *left* side will be found empty, and the whole arterial blood will be, as the venous, of a dark color All the abdominal viscera will be engorged with blood.

The *lungs*, in cases of hanging and mechanical obstruction, present no characteristic appearance, but in those of drowning they will be more or less filled with water or the drowning medium, and incapable of collapsing, and will feel heavy and doughy to the touch. The air-tubes, moreover, will be choked with a sanious foam composed of blood, water, mucus, and often foreign matter churned up with the air of the lungs. Frothy water mixed with blood will also pour out of any section of the lung. These points were clearly stated by the Committee of the Royal Med. and Chir. Society on suspending animation, and recorded in the 'Transactions' for 1862.

DROWNING.

How long a human being may be under water, and yet recover, is an important question, but the answer depends upon many considerations. Dr. Sanderson believes he has demonstrated by experiments that in animals the duration of life turns upon the amount of air confined in the chest at the time of immersion; that when the animal on immersion fills its chest with water by an inspiratory effort, death is most rapid; but if the chest be full of air at the time, and no such inspiratory effort takes place, life may be prolonged for several minutes. The occurrence of syncope at the moment of immersion, whether from fright, shock, or previous injury, is consequently a happy accident, the respiratory act being materially diminished by the syncope. "If a person be completely submerged," writes Dr. W. G. Harley in 'Holmes's System,' "and the entrance of water to, and exit of air from, the lungs not prevented, we believe that recovery would be impossible after two minutes. On the other hand, if the air-passages were closed against the entrance of water, and the chest kept full of air, we see no reason for thinking that a human being would perish either more slowly or more quickly than a dog placed under similar circumstances, namely, in from four to five minutes."

Death by *strangulation* is due to asphyxia alone, and, as a rule, is homicidal, being consequently often complicated with other injuries.

Death by *hanging* is of a mixed form; since in addition to the strangulation by the cord, there is the added traction on it by the weight of the falling body.

Hanging causes death, according to Dr. A. Taylor, "commonly from apnœa, but sometimes from apoplexy, caused by pressure on the jugular vein, being preceded by convulsions, often lasting for many minutes, but in all probability not accompanied by more than momentary pain. Occasionally there is found displacement or fracture of the first or second of the vertebræ, with compression of the spinal marrow. This cause of death is only likely to be observed in corpulent or heavy persons, when a long fall is allowed by the cord, and is seldom met with in judicial executions." This latter fact is supported by the observations of Dr. Barker, of Melbourne, who informed Professor Haughton, of Dublin, that in fifty-four post-mortem examinations of criminals hanged according to the old or "short-drop" system, in not a single case was there dislocation or fracture of the neck. In the following plan, however, introduced by Dr. Barker this dislocation was the rule. Dr. Haughton quotes his words ('Med. Times and Gaz.,' June 21st, 1871): "I have the knot put about two inches from the spine, so that when it is tightened by the weight of the body the knot comes on the vertebræ; by the fall the body has an impetus forwards, the resistance being at the beam to which the rope is fastened. The knot acts as a fulcrum to push the head forwards. By this arrangement I have found in all cases there was a dislocation and fracture of the cervical spine and pressure on the cord, laceration of the muscles of the larynx, and generally fracture of the hyoid bone, death being always sudden and complete, no long drop is required." To the Irish and American long-drop system there are grave objections. When the cord is crushed, death is instantaneous; when not so injured, life may be prolonged for minutes, usually about three; but there is no evidence to believe that the period may be extended to ten. Conscious life, under both circumstances, probably is soon lost, rarely extending beyond the *three* minutes.

When the cord is not injured, Taylor computes that life may be restored after five minutes of suspension, and Tardieu, an eminent French writer, gives a similar period.

TREATMENT OF APNŒA OR ASPHYXIA.

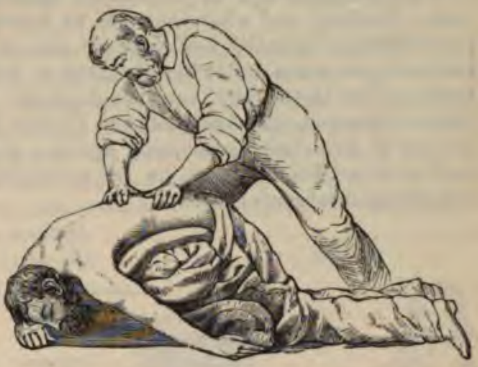
All obstruction to the passage of fresh air to and from the lungs is to be at once, so far as practicable, removed, all froth and mucus to be cleansed from the mouth and nostrils, and all tight articles of clothing to be at once taken away from the neck and chest. In slight cases of temporary apnœa the treatment is as in syncope: dropping the head, which should be low in all cases, a dash of cold, or alternately of cold and hot water to the face, or a smarting slap upon the epigastrium, generally sufficing to revive the patient. When this proves useless, artificial respiration should be instantly commenced.

The methods of artificial respiration which have been successively in use are those of the late Drs. Marshall Hall and Silvester; but I believe the best method to be the one more recently advocated by Dr. Benjamin Howard, of New York. This "direct method," as the author calls it, was first published in the form of a prize essay by the American Medical Association in 1871, and has since been adopted by the United States Government Life Saving Service, the Life Saving Society of New York, &c. It is eminently simple and effective, and is to be applied in the treatment of the drowned as follows, the rules having been drawn up for me by Dr. Howard:—

RULE 1.—FOR EJECTION AND DRAINAGE OF FLUIDS, &C., FROM THE STOMACH AND LUNGS. *Position of Patient.*—Face downwards with forehead resting upon the forearm or wrist to keep the mouth from the ground, and a hard roll of clothing beneath the epigastrium, which should be the highest point, while the mouth is the lowest. (Fig. 318.)

Position and Action of Operator.—With the left hand well spread out upon the base of the thorax to the left of the spine, and the right hand upon the spine, a little below the left, and over the lower part of the stomach, the operator should with a forward motion throw upon them all the weight and force the age and sex of the patient will justify, ending this pressure of two or three seconds with a sharp push, which helps to jerk him back to the upright position. And this movement should be repeated two or three times, according to the period of submersion and other indications.

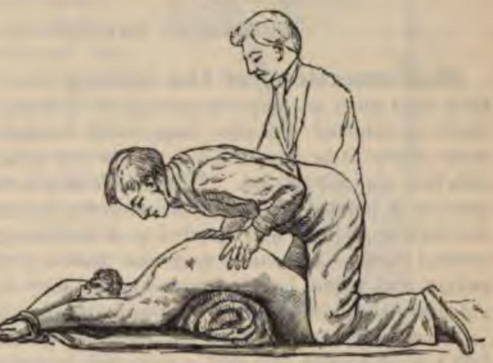
FIG. 318.



RULE 2.—*Position of Operator.*—In a kneeling posture, astride patient's hips. His hands upon the chest, so that the ball of each thumb and little finger rests upon the inner margin of the free border of the costal cartilages, the tip of each thumb near or upon the xiphoid, and the fingers fitting into the corresponding intercostal spaces. The elbows firmly fixed, making them one with the sides and hips; then—TO PERFORM ARTIFICIAL RESPIRATION. *Position of Patient.*—Rip or strip clothing from the waist and neck. Face upwards; shoulders slightly declining over. Hard roll of clothing placed beneath thorax; the head and neck bent back to the utmost, with the hands on the top of the head (one twist of handkerchief around the crossed wrists keeping them there) (Fig. 318*a*).

The Operator pressing upwards and inwards towards the diaphragm, using his knees as a pivot, and throwing his weight slowly forwards two or three seconds, until his face almost touches that of the patient, should end with a sharp push, which helps to jerk him back to the erect kneeling position. He should then rest three seconds, and repeat this bellows-blowing movement as before, continuing it at the rate of seven to ten times a minute, taking the utmost care on the occurrence of a natural gasp gently to aid and deepen it into a long breath until respiration becomes natural. When practicable, the tongue should be held firmly out of one corner of the mouth with the thumb and forefinger armed with dry cotton rag.

FIG. 318*a*.



Artificial respiration by direct method.

Avoid all impatient vertical pushes; the force upward and inward must be increased gradually from zero to the maximum the age, sex, &c., may indicate. Abandon no case as hopeless within an hour's useless effort.

In the application of this method to cases of stillbirth, the child lies along the left hand of the operator, the ball of whose thumb takes the place of the hard roll of clothing seen in Fig. 318*a*. Over this the shoulders decline, the head falling back with the arms, if convenient, on either side the face. The buttock and thighs are supported by the operator's fingers.

Thus the operator has the prominent little thorax completely within the grasp of his right hand with firm counter-pressure behind, enabling him to apply, locate, distribute, direct, or alternate his pressure as he pleases. The advantages Dr. Howard claims for this method over other methods are—1st. It provides for ejection and drainage of fluids, &c., from the stomach and lungs, and in such a way that each motion for ejection induces an alternate inspiration. 2d. It excludes the tongue from the pharynx without manipulation. 3d. It secures elevation of the epiglottis and a post-oral air-way from the glottis to the nares. 4th. It includes a remedy against snycope and cerebral anæmia. 5th. It obtains a more general expansion of the thorax. 6th. It effects a thoracic compression which is more complete, better distributed, directed, and regulated. 7th. It is done by one person, and can be applied instantly on the spot wherever the patient is found. 8th. It is more easily understood by the illiterate, is less fatiguing to the operator, and is free from unnecessary motion or violence.

When respiration is re-established maintain the temperature of the body by friction, warm blankets, and when possible by warm water (106° F.), or air bath, keeping the head where a circulation of pure air may be maintained. As soon as the patient can swallow give warm milk, beef tea, tea or coffee, with a tablespoonful of some spirit, or these may be injected by the stomach-pump. When respiration is restored put the patient into a warm bed, with hot bottles to his feet, and encourage sleep, but let him be watched in case of secondary or relapsing apnœa; at the slightest symptoms of which let friction and even artificial respiration be re-employed. Give volatile stimulants such as the spiritus ammoniæ aromaticus.

SURGERY OF THE URINO-GENITAL SYSTEM.

CHAPTER XX.

DISEASES OF THE KIDNEY.—STONE.—NEPHROTOMY.

Malformations of the kidney have more scientific than surgical interest, yet they may have an important surgical bearing, for when any accident from external violence or internal irritation happens to a single or imperfect organ, the life of a patient is more likely to be jeopardized than when it is normal. In a case recorded in page 433, this fact was illustrated. When a kidney is single, it is usually large, and sometimes the form of a horseshoe; when it assumes a central position, with the convexity of the curve downwards, it may be regarded as a double organ, the vessels entering from above in their normal way. A kidney may also hold a position nearer the pelvis, or even lie in the pelvis, and when loosely connected, it may appear in the abdomen as a movable tumor. At times the adult kidney maintains the lobulated character it possessed in fœtal life.

The diseases of the kidney are generally regarded as belonging to the physician, but I need hardly add that a thorough knowledge of renal pathology is as requisite to the surgeon as it is to the medical practitioner, for, without such a knowledge, he will be unable to recognize the different conditions of the urine with its deposits, and to appreciate their significance. He will also be unfit to decide upon the propriety of an operation of expediency, or to understand the risks of one of necessity; for the existence of kidney disease, as a rule, is enough to debar the surgeon from performing any operation other than that required to save life, and in such operations it renders the prognosis most unfavorable, since it is well known that the chief cause of death after operations is kidney disease, and the worst forms of the disease are undoubtedly due to calculous affections, to vesical and urethral mischief.

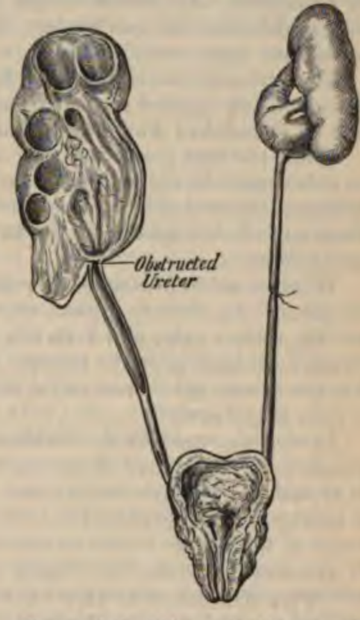
In all cases of operative surgery the condition of the kidney, as recognized by the urine, should be made out, and in disease of the urinary organs a most careful examination is equally required.

NEPHRITIS.

Inflammation of the kidney associated with suppuration of the organ has long been recognized as a common consequence of the obstructive disease of the urinary passages. But it may occur as a consequence of local injury, or as an acute attack upon a chronically diseased organ; as a consequence of pyæmia or other cause. It is also very common as a sequel to Bright's disease of the kidney—that is, to disease of the secreting glandular structure of the organ—in consequence of some local source of irritation in any part of the urinary passages. Bright's disease by itself is not a suppurative disease. Suppurative nephritis may occur as an *acute* affection, or as a *chronic* though more frequently as an *acute upon a chronic.* After death, a kidney thus affected may appear enlarged, with its substance more or less filled with suppurating cavities. When the inflammatory action is confined to the mucous lining of the pelvis of the organ, it is called "*pyelitis.*" At times, the kidney is a mere cyst or shell containing pus and broken-down tissue, and, in extreme cases, the kidney and parts around form one large suppurating cavity. This result is not rare as a consequence of the breaking up of tuberculous matter.

Symptoms and diagnosis.—When after an injury in the loins, or in the course of some obstructive vesical or urethral disease, or calculous affection, a patient is seized with rigors, severe pain and tenderness in the lumbar region, febrile disturbance, nausea, vomiting, scanty, high-colored, and possibly bloody urine, and irritable bladder, *acute nephritis* may be suspected. When rigors recur frequently and there is suppression of urine with renal casts or pus in the urine, suppuration of the organ is to be diagnosed; and, when to these symptoms are added severe depression, anasarca, and brain symptoms passing on to coma, uræmic poisoning may safely be expected.

FIG. 319.



Disease of the kidneys, bladder, etc., the effect of urethral obstruction. Drawing 368^{55}, Guy's Hosp. Mus.

The more free *blood*-cells there are in the urine the greater are the probabilities of renal hemorrhage; the more *pus*, the greater the likelihood of renal disease.

But **chronic nephritis** is a more common affection than the acute; indeed, unless from accident, the acute is generally a sequel to the chronic. Kidney disease is a common consequence of long-standing or neglected bladder or urethral mischief. When a stone has existed for any period in the bladder, and has set up inflammation of that organ; when from prostatic disease the same result ensues, or when from stricture the bladder, ureters, and kidneys have been subjected to the irritation and its consequences of distension from retained urine, the ureters become affected from the extension of mischief from the bladder, then, too, the pelvis of the kidney, and subsequently the secreting structure of the kidneys themselves. Under these circumstances, every gradation of dilatation, inflammation, or suppuration of the whole urinary passages may be found, the bladder may be enormously thickened and inflamed; the ureters dilated, tortuous, thickened, and suppurating; the pelvis of the kidney expanded and filled with pus—"*pyelitis*"—and the kidney itself more or less undergoing disorganizing changes. (Fig. 319.)

The symptoms of changes such as these are not very definite. In all *long-standing* examples of obstructive urinary affections some of these may be suspected, as well as in all cases of neglected stone, particularly when bladder symptoms are marked; when the urine is albuminous, pale colored, and smoky, or tinged with blood; when it contains pus in suspension, varying in quantity at different times, or shreds of lymph; when a dull aching pain is present in the loins, shooting round the hips into the groin and down to the testicles, and, when the digestive organs do their work badly, and sleep is difficult to secure or superseded by a general drowsiness.

Under these circumstances, chronic kidney disease may fairly be diagnosed with or without suppuration in the organ or around it.

When anasarca sets in, or brain symptoms from uræmic poisoning appear, the diagnosis is clear.

When rigors are frequent, even when not well marked, when lumbar pain is constant and increased on pressure, when on manipulation, evidence exists of some deep-seated lumbar swelling and fluctuation is distinctly or indistinctly to be made out *abscess of the kidney* is fairly indicated. When with these a sudden discharge in the urine of large quantities of pus takes place, with relief to the local symptoms, it is probable that the abscess has discharged itself through the ureter; when the lumbar pain becomes more intense, the swelling more marked and prominent, and fluctuation more distinct, it is probable that the ureter has become obstructed and the renal abscess is making its way one person, and can be applied instantly on the spot wherever the patient is found. 8th. It is more easily understood by the illiterate, is less fatiguing to the operator, and is free from unnecessary motion or violence.

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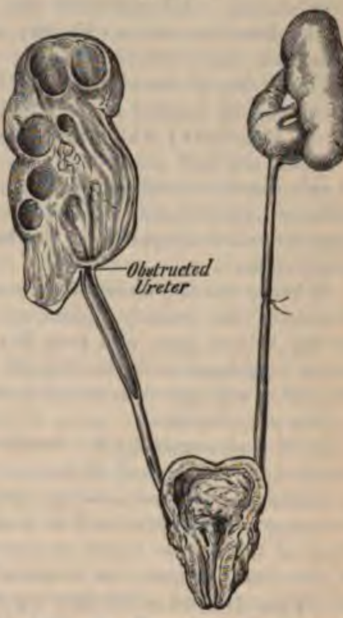

Disease of the kidneys, bladder, etc., the effect of urethral obstruction. Drawing 368^54, Guy's Hosp. Mus.

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Under these circumstances, chronic kidney disease may fairly be diagnosed with or without suppuration in the organ or around it.

When anasarca sets in, or brain symptoms from uræmic poisoning appear, the diagnosis is clear.

When rigors are frequent, even when not well marked, when lumbar pain is constant and increased on pressure, when on manipulation, evidence exists of some deep-seated lumbar swelling and fluctuation is distinctly or indistinctly to be made out *abscess of the kidney* is fairly indicated. When with these a sudden discharge in the urine of large quantities of pus takes place, with relief to the local symptoms, it is probable that the abscess has discharged itself through the ureter; when the lumbar pain becomes more intense, the swelling more marked and prominent, and fluctuation more distinct, it is probable that the ureter has become obstructed and the renal abscess is making its way through the loin externally; and cases are on record in which, after the discharge of the abscess by natural or surgical means, a recovery has ensued. Indeed, stones have been discharged from the kidney in this way with a good result.

Renal abscesses are, however, prone to make their way through the diaphragm into the lung or into the colon, rare cases being recorded where they burrowed downwards and appeared below Poupart's ligament, or in the pelvis. In these cases, the symptoms simulate spinal disease, the thigh being flexed upon the pelvis: this symptom too, attended with lumbar pain or tenderness, is very constant in nephritic abscess. Dr. Bowditch, of Boston, was the first to draw attention to the fact in 1869 and 1870.

TREATMENT.—When acute nephritis originates from a blow or from the irritation of a renal calculus, complete rest in the horizontal posture in a warm bed is absolutely essential, with *milk diet* and the moderate use of simple diluents as milk and water, or barley water. Poppy fomentations to the loins always give comfort, and, when the pain is severe, leeching is beneficial; cupping has been recommended, and is practised by some. The bowels should always be well cleared out by some simple medicine such as castor oil or an enema. All medicines that act upon the kidney as salines or turpentine, all external applications such as blisters, should be carefully avoided; and for this same reason stimulants ought not to be given.

The action of the skin should be encouraged by outside warmth, and the hot-air bath or steam bath applied to the patient in bed is a valuable means to this end; a hot bath is a good substitute; while calomel and antimony cannot be recommended.

When the case passes into the chronic stage, counter-irritation becomes of value, and as this cannot be obtained by means of blisters, since cantharides acts powerfully on the kidneys, mustard may be employed, or a piece of lint saturated with a mixture of chloroform and alcohol applied to the loin and covered with oil silk. Dry cupping, also, is of great value.

When *acute nephritis* supervenes upon the chronic form the result of long-standing disease of the urinary organs, or, after operation, the whole aim of practice must be to soothe, relieve pain, and keep life going. Nothing like mechanical interference with the urinary passages must be thought of. Retention of urine should, of course, be relieved, but the utmost gentleness ought to be employed in the manipulation. These cases are, as a rule, very hopeless.

In *chronic nephritis* the result of local disease, there can be little doubt that the best practice is the removal of the cause. When a stone in the bladder has set up the mischief it should be removed, and by that mode which induces the least local irritation. When a stricture of the urethra has been the cause, it should be dilated, for as long as the local cause of the disease exists no recovery can be looked for. When calculus in the kidney is the local irritant, the surgeon's aim must be to allay local irritation by keeping the patient quiet, and administering soothing remedies; the alkaline potash salts being prescribed where the urine indicates uric-acid calculus, and the mineral acids when the urine is phosphatic. The removal of the stone by operation may also be entertained.

When suppuration of the kidney takes place, with or without a calculus, and any external evidence of the abscess exists, an opening should be made; though it is a moot question with surgeons at the present day whether it is not better practice to anticipate this pointing by an early incision.

When the urine is full of pus, the preparations of buchu are of undoubted value, and the mineral acids or the preparations of iron of use.

Warm baths and diaphoretics to induce free action of the skin, and by these means to relieve the kidney, with a supply of simple nutritious food and stimulants only when absolutely required, make up the treatment.

Perinephritis is an affection that must be recognized, and, although it may be more frequently found in connection with suppuration of the kidney, it is at times independent of it. It is indicated by a sudden pain in the loin, fever, and subsequently *lumbar swelling*, with frequently œdema of the integuments of the loin. The pain is at times constant and persistent, while at others it may appear and then disappear for an uncertain interval, to recur spontaneously in all its severity. The urine in an uncomplicated case is generally natural, and if at all altered, scanty; renal symptoms, so-called, being absent. When the case is left to nature, the inflammation may attack the chest and induce a fatal pleurisy, or the abscess may burst into the bowel or externally, burrowing beneath the fascia covering the psoas muscle and showing itself in the thigh or pointing in the loin. The surgeon should not, however, leave these cases to nature, but cut down upon the abscess or lumbar swelling, as in colotomy, at the outer border of the quadratus lumborum muscle, and evacuate the pus as soon as sufficient evidence exists of its presence; when a good result may be looked for. (*Vide* paper by Dr. Bowditch, 'Am. Journn. of Med. Science,' 1871.)

HÆMATURIA

is a symptom met with in many diverse conditions, the hemorrhage being limited or profuse. It may come from one or both the kidneys or any other part of the urinary passage, either as the result of some constitutional cause, such as the hemorrhagic diathesis, or, some morbid condition of the blood, as in purpura, scurvy, smallpox, the plague, or fever. Profuse renal hæmaturia takes place occasionally as an intermittent affection. It may likewise follow an injury or disease of the kidney, ureter, bladder, prostate, vas deferens, or urethra. In surgical practice the hemorrhage is more frequently due to some local cause, yet the practitioner should be alive to the fact that it may originate from a constitutional, or the use of such a drug as turpentine or cantharides.

If the hemorrhage follow an accident, the diagnosis is seldom difficult, for when after an injury to the loin, blood is passed mixed with the urine, it may be inferred that the kidney has been injured, and when slender, cylindrical, pale pieces of fibrin are seen in the urine the surgeon may be sure that they come from the kidney—these clots having been moulded in the ureter and washed down from the kidney by the urine. Blood also, when intimately mixed with the uterine, has probably a renal origin.

The passage of a stone down the ureter is also attended by hemorrhage, which is rarely profuse, and is, moreover, generally accompanied by severe colicky pain shooting down the groin and scrotum of the affected side, with a retracted testicle. When blood comes from a diseased kidney, it is mixed with the urine, as in cases of accident, and may be slight or profuse in quantity, but the nature of the affection or its being due to calculus will have to be determined by the history of the case, the existence of lumbar pain or tenderness, and a close examination of the uterine. In cancer of the kidney pain rarely extends to the testicle.

Vesical or prostatic hemorrhage, either from injury or disease, chiefly shows itself as blood clots mixed with the urine, the former passing either before or after the latter. The blood at first may fill the bladder; but after some days the urine will only be stained with blood. When the clot has broken up more or less discolored irregular coagula with fimbriated edges will pass with the urine, these coagula being very characteristic of blood-clot. They may pass per urethram as rolled-up masses, but, when floated out in water will present their natural shape; blood that has been retained within the bladder for any time will impart to the urine a porter-like aspect.

When blood flows at the end of micturition in small quantities, squeezed out, as it were, by the bladder, a calculus or prostatic disease may be suspected; but the same condition is also occasionally met with in the irritable bladder of gonorrhœa, or, after the passage of "gravel."

When a cancer of the bladder or prostate, or a villous growth exists pieces of broken up tissue may be detected by the microscope in the bloody urine. In these cases, too, the hæmaturia will be intermittent.

Urethral hemorrhage.—When after an injury to the perineum or pelvis, or a sudden muscular strain, pure blood flows from the urethra, unmixed with urine, urethral mischief may be suspected.

Urethral hemorrhage irrespective of injury may proceed from a chancre, an acute gonorrhœa, or an impacted stone. It may follow over-exertion, or the straining associated with retention of urine or sexual intercourse. It may likewise take place after the forcible bending of an erect penis in a chordee, or during some sudden muscular exertion from a rupture of the vas deferens, as pointed out by Hilton, and, in rare cases, it may occur without any known cause, the blood flowing from the penis unaccompanied by any symptom of disease. I have recorded two such cases ('Clin. Surg.,' Chapter 47).

Urethral hemorrhage as a result of catheterism is also common, and may be caused by the introduction of some foreign body into the urethra.

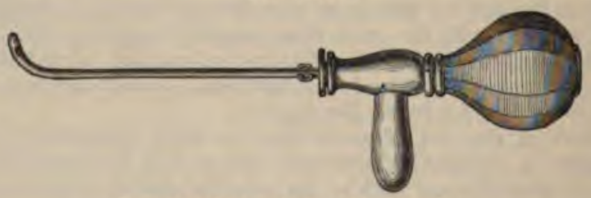
It should be remembered also that bile when concentrated, indigo, or other rare constituents of the urine, from diet or otherwise, may simulate the presence of blood, as may the black urine which results from the external or internal use of carbolic acid when absorbed in poisonous doses. This symptom, however, soon disappears on the omission of the remedy. In a case under my care in 1871, of a man who had a weak sore the size of a crown piece, which had been dressed with an oily lotion of carbolic acid one part to forty, the black urine appeared after the second dressing, associated with brain symptoms and collapse of the general powers, which I thought must prove fatal. The symptoms however, speedily disappeared on withdrawing the drug, and a recovery ensued. In a more recent case, a boy æt. 9, was unintentionally kept in a semicomatose state for two months by the application of a lotion of carbolic acid (one part to a hundred) to a small sore, the brain recovering its healthy condition on the omission of the lotion. The poisonous action of the carbolic acid was detected through the urine, which was occasionally black.

TREATMENT.—The disease or condition that gives rise to the blood in the urine requires treatment more than the symptom itself, but at times, the bleeding is so profuse as to threaten life. Renal hemorrhage when profuse, may be checked by gallic acid in full doses, gr. v to gr. x three times a day, acetate of lead, tincture of ergot, or matico, opium being generally a valuable addition, and, in extreme cases, the spirit of turpentine, absolute rest in the horizontal position, and cold milk diet being also adopted.

Hemorrhage from the bladder, when persistent, may be checked by the application of a bag of ice over the pubes and to the perineum; by cold or astringent injections into the rectum, with rest and opium, and there is no necessity to pass a catheter or to interfere with the clot, so long as the urine flows and retention does not occur—the urine at the natural temperature of the body being a good blood solvent. A clot of blood, when bathed with urine, as a rule so disintegrates in the course of a few days as to allow of its being passed without help. Any disturbance of the clot when first formed will probably rather tend to encourage than stop bleeding, consequently, no unnecessary catheterism should be employed.

When retention exists, the symptoms become urgent, and opium administered either by the mouth, or, what is preferable, by the rectum, fails to give relief, the passage of a large-sized catheter and the use of an exhausting syringe, such as Clover invented for use after lithotrity (Fig. 319A), or the aspirator may be called for; yet these measures should only be employed when an absolute necessity exists, and opium in full doses fails to give relief.

FIG. 319A.



Clover's syringe, as improved by Maunder.

Urethral hemorrhage rarely continues for any time, or requires for its treatment more than rest in the horizontal posture, unless caused by some laceration of the urethra or more severe injury.

SUPPRESSION OF URINE

is the result of renal disease. The kidneys cease to fulfil their functions, and the constituents of the urine being left in the blood give rise to coma and possibly to convulsions and death. Uræmia or uræmic poisoning is then said to be the cause of death. It may occur at any stage of kidney disease, and not uncommonly follows an operation performed on a patient the subject of such an affection; it is a result to be taken into calculation where albuminous urine exists before undertaking any operation.

In exceptional cases, however, suppression of urine occurs when no such chronic mischief can be detected, coming on suddenly, as it often does, without cause, and leaving as suddenly without any reason. I once saw a musician who secreted no urine for sixty hours, and then passed what seemed to be a natural quantity; his only other symptoms being those of slight feverishness and headache. In such cases, the hot air, vapor, or warm bath are the best remedies.

Stone in the kidney is not an uncommon affection, though generally painful and often fatal. When the stone becomes impacted in the organ and ceases to be movable, it does not give rise to any marked symptoms, and, comparatively speaking, ceases to interfere with life; more frequently, however, it often excites much local irritation, if not suppuration, and usually kills by destroying the kidney which becomes a suppurating cyst. Small stones are constantly formed in the kidney and passed through the ureter into the bladder. Large stones may so increase as to form a cast of the pelvis of the kidney (Fig. 336), and at times attain enormous dimensions.

The symptoms of stone in the kidney are, a tendency to rigor, lumbar pain increased by riding or any jolting of the body, the pain passing down the groin into the testicle of the affected side and causing its retraction, irritable bladder, and blood in the urine. Dr. Owen Rees has pointed out the value of the tincture of galls, added guttatim to the urine of patients who may be suspected to be suffering from renal calculus, this tincture producing an immediate flocculent precipitate of a light brown color when any of the extractive matters of the blood are present ('Brit. Med. Journ.,' Oct. 21, 1876, p. 518). He also asserted that a heavy and continued pain over the sacrum may be the only prominent clinical symptom of this affection. When the stone enters the ureter, the inguinal and testicular pain becomes increased, and a colicky pain appears, attended often with sickness and even collapse, the bladder becoming more irritable and the urine more bloody. When the stone passes, all these symptoms suddenly cease, the bladder irritation probably alone remaining.

When the stone is in the kidney, lumbar pain shooting down towards the groin is the most common symptom; while exercise, or any quick movement that may stir the stone, excites irritability of the bladder and hæmaturia. And, as time goes on, and the local irritation becomes worse, some suppuration in the kidney will occur. As long as the ureter remains open, and pus makes its escape into the bladder, the symptoms are not urgent; but should the ureter become closed by the stone or some inflammatory change, the pus will collect and give rise to lumbar renal abscess. At times, this lumbar swelling may be felt; indeed, in thin subjects, with one hand in the lumbar and the other in the hypochondriac region, a calculus may by palpation even be made out in the kidney, and this examination can be made occasionally with advantage with the patient under chloroform. The lumbar swelling may so increase as to form a large cystic abdominal tumor. When the ureter is obstructed, this result will take place more rapidly than when it is open, as the pus accumulates; but when it is open the pus flows into the bladder and passes with the urine as turbid urine. When allowed to settle in a porringer or glass, its presence will be readily detected. Pus poured into the bladder from the kidney or elsewhere is mixed with but little mucus; but when formed in the bladder is mixed with a great deal.

Treatment.—When a stone has formed in the kidney, the happiest result is its passage into the bladder, which end can be facilitated by the administration of diluents, particularly water, as well as alkaline preparations of potash, such as the citrate, tartrate, or bicarbonate. When strong evidence exists of local irritation, opium or henbane, given either by the mouth or the rectum, are valuable drugs; while a subcutaneous injection of morphia over the affected kidney at times acts most beneficially. Fomentations about the loin and groin, or the warm bath, also give much relief.

When the stone is passing down the ureter, the same practice is to be followed, a warm bath and a full dose of opium often relaxing the parts and favoring the passage of the stone. The administration of chloroform by inhalation may, when the pain is severe, under these circumstances also be tried. In a case I was called upon to see, where extreme agony existed, instantaneous and permanent relief followed the practice, the stone having passed during the inhalation of the chloroform.

When the stone has become impacted in the kidney and gives rise to periodical attacks of pain and constant uneasiness—each attack being worse than the last—important questions occur to the surgeon. Is it to be allowed to remain, where it may, in all probability, set up irremediable disease if not destruction of the kidney? or, is an attempt to be made to remove it by surgical operation? Is a surgeon justified in cutting down upon a suppurating kidney, whether resulting from a stone or other cause, and giving free exit to the pus, or, removing the stone? Is nephrotomy an operation to be performed?

Nephrotomy.

It is impossible to enter into all the questions involved in the operation of nephrotomy, but, after full consideration, I have no hesitation in expressing my belief, that when with scientific certainty it has been made out that a stone is impacted in a kidney, and it has been proved from the lapse of time that the probabilities of its passage into the bladder are too feeble to rely upon; when, from repeated attacks of renal irritation, hæmaturia and the discharge of pus with the urine, it is clear that serious organic changes are going on which must lead to the destruction of the kidney, and thus probably of life, an exploratory operation in the loin down to the affected organ is not only a justifiable but a conservative and scientific operation, and these observations are still more applicable when renal abscess can be made out.

I have proved this in practice on several occasions, having in a man cut down upon a suppurating kidney and evacuated several ounces of pus with marked benefit, and in another opened a large suppurating renal cyst through the left loin. In either case, had a stone been present, it could have been readily removed.

On August 31st, 1876, I likewise cut down upon the right loin of a lady, æt. 27, whom I saw, in consultation with Dr. Moore and Mr. Pocock, of Brighton, with a swelling which we diagnosed as renal, and evacuated three pints of fetid pus—the lady making a good recovery. In 1877 I cut into the left loin of a woman with a lumbar swelling, and let out a quart of pus with marked benefit, my finger readily passing into the dilated pelvis of the kidney. The operation is not one of difficulty, nor of danger; in both these respects it is on a par with lumbar colotomy, and it is probable that, in a few years, it will be as recognized an operation.

The operation in its several steps, should be the same as that described for lumbar colotomy, the kidney being readily reached and dealt with through such an incision as was there indicated. The operation is based on an imitation of natural processes, as stones have been discharged through openings in the loins. Before it is undertaken, however, the diagnosis of an impacted stone or a suppurating cyst ought to be almost certain.

With respect to the *extirpation of the kidney*, I am not prepared to speak so decidedly; nevertheless, it must be recorded, that out of twelve cases in which it has been performed, four recovered.

Dr. Brant, of Klausenburg, on June 7, 1872, removed the left kidney of a man, æt. 27, which had escaped from the loin through an opening caused by a stab four days before. He tied its pedicle in two portions with a silken ligature, and recovery took place without a bad symptom. ('Wiener Med. Woch.,' Nov. 29, 1873.)

On December 2, 1873, Dr. A. Campbell, of Dundee, removed the kidney that was the subject of cystic disease through an abdominal incision, having mistaken it for an ovarian tumor, and the patient, who was a widow, æt. 49, made a good recovery. The pedicle was ligatured with carbolized catgut. ('Edin. Med. Journ.,' July, 1874.)

Dr. Simon, of Heidelberg; Langenbeck, of Berlin; and Dr. J. T. Gilmore, of Alabama, have likewise removed atrophied kidneys with success.

With these facts before us, the subject is certainly open to consideration, and the operation need not be classed amongst the unjustifiable operations.

The reader may refer to an interesting paper on this subject in the 'Med.-Chir. Trans.' for 1869, by Mr. Thomas Smith, and also to the 'American Journal of Med. Science,' January, 1873, and July, 1874.

CHAPTER XXI.

DISEASES OF THE BLADDER AND PROSTATE.

IRRITABLE BLADDER.

ALMOST every disease of the urinary organs manifests its presence by some bladder symptom, and that symptom is usually what is called an *irritable bladder*, that is, the patient passes urine more frequently than natural, with or without pain.

Such a symptom may indicate some slight deviation from the healthy relations that ought normally to exist between the bladder and its contents; or the presence of a severe if not fatal organic disease. It may be a result of some irritation of the glans penis associated with retained sub-preputial secretion, or an adhesion between the glans and prepuce; or, it may be due to a serious cerebral or spinal affection. It may indicate kidney, bladder, prostatic, or urethral disease, and, in many instances, it is the one symptom that has induced the patient to seek advice. The "[illegible]ble *bladder*," therefore, though only a symptom, is clinically an important one, and demands elucidation at the commencement of a chapter on bladder affections.

Irritability of bladder in children.—When this symptom is well marked in a male child, the condition of the penis should first receive attention; since, if the prepuce be long or adherent to the glans penis, and the secretion from Tyson's glands from want of cleanliness, have accumulated and become indurated, there will be strong reason to believe, that the irritability of bladder is the direct product of these apparently simple causes, for any of these conditions of the penis are sufficient to produce every degree of bladder irritation, and a cure can only be obtained by their removal. To secure this end, all retained secretion should be taken away, adhesions between the glans penis and prepuce carefully separated, and, if the prepuce be long, circumcision performed. If, however, on a careful examination no such conditions are to be observed, the state of the bladder should be inquired into, and for this purpose a sound passed (an instrument with a bulbous extremity being preferred) (Fig. 343), and, if a stone be detected, the cause of the symptom will be clearly explained, as well as the practice to be followed. It must be remarked, also, that if a calculus be the cause, a careful inquiry will probably detect the presence of other symptoms such as pain after micturition, hæmaturia, and an occasional interruption of the flow of urine—the intermitting urinal flow being very characteristic of the presence of a stone, although all these symptoms may be present in irritable bladder from an adherent prepuce. When the stone cannot be felt, it is not at once to be assumed that no such cause exists; for, on a subsequent examination, it may readily be discovered, the calculus having been probably covered by one of the folds of mucous membrane of a partially contracted bladder. If, however, a second examination fail to strike it, the condition of the bladder should receive attention; and if to the sound its mucous lining feels rough, and the presence of the instrument cause more or less pain and a desire to micturate, the urine will probably be found altered in character, and, after standing, to show a cloudy deposit of mucus, if not of pus; the latter deposit being very rare, however, in young subjects. Under these circumstances the general health of the child will require attention, as it may happen that some slight aperient or alterative or an alkaline mixture of potash, or perhaps a tonic may be required; the object being to make the urine as unirritating as possible, and thereby to allow the vesical mucous membrane to return to its normal condition. Rest, also, as far as it is possible to be secured, should be enforced. The diet ought to be of the simplest nature, and meat given in moderation, since it will probably be found that the urine is unnaturally loaded with lithates, if not with lithic acid, and this tendency to the deposition of such ingredients would be increased by the free administration of animal food. When, however, a case of irritable bladder in a child presents itself, in which none of the conditions alluded to are found, and in which the penis, urethra, and bladder, appear perfectly natural, the state of the rectum should be inquired into; the presence of worms, and more particularly of ascarides, being quite sufficient to produce an irritable condition of the urinary organs. These may be removed by a jalap purge or an enema of some bitter vegetable infusion, such as quassia; but the condition of the digestive apparatus will require attention, as influencing the presence of worms.

Excluding the presence of a stone as a cause of irritable bladder in young children, this affection is not one of serious importance if its true cause can be accurately recognized; since the conditions upon which it depends are easily remediable, and the irritability of bladder rapidly disappears on their removal.

Irritability of bladder in the adult.—In adult life, this symptom cannot be regarded in such a favorable light as in a child, since it is too often associated with conditions which are of a very serious nature and are by no means readily removed, although in the adult, as in the child, a congenital or an acquired phimosis, with a contracted preputial orifice, or adhesions between the prepuce and the glans penis, are sufficient conditions to produce this symptom.

As a symptom of stricture, the irritable bladder is not without its value; and, as a rule, it indicates considerable narrowing, as well as probably a contraction which has been so gradual in its progress as to escape notice until this irritability of bladder enforced more accurate observation, and induced the patient to seek advice. It must be regarded as a result, therefore, of a urethral stricture which can only be relieved by the removal of its cause. Doubtless it is produced by some chronic inflammatory action of the vesical mucous membrane, and, as such, requires treatment, viz., the dilatation of the stricture, absolute rest, and the administration of alteratives.

As a symptom of *enlarged prostate* (or of atony of the bladder in the aged, in whom no prostatic enlargement exists) this irritability of bladder is a complication of serious import, for in both classes of cases it is due to a want of power on the part of the bladder to empty its contents; in the one case from a mechanical obstruction caused by the prostatic tumor, in the other from a loss of power in the parts—the residual urine under both partially decomposing becomes ammoniacal, and in this way acting as an irritant to the mucous membrane of the bladder, thereby giving rise to the irritability.

The treatment of these cases is not, therefore, a task of difficulty; the removal of the residual urine, and the prevention of its subsequent retention by the cautious employment of a catheter being the most important, together with the frequent washing out of the bladder with warm water, or, water medicated by some solution of morphia, opium, quinine, or nitric acid.

The recognition of the cause of the symptom, however, is the main point to be remembered, the practice to be followed readily suggesting itself when the cause is understood. As a sign of gravel, an irritable bladder is of importance, and a careful examination of the urine will determine its true meaning. As a symptom of calculus in the bladder, it is constant and valuable, although in some cases of stone it is extraordinary how little irritation the presence of a calculus will produce. As a sign also of organic disease of the bladder, irritability must not be passed over. The obscurity of this class of cases is, however, very great, and the correctness of diagnosis must rest upon the combination of many symptoms, none being of greater value than another. In women, this symptom is a common accompaniment of uterine affections, while in both sexes it is often associated with rectal disease.

Lastly, this irritability may be the product of a renal affection, the urethra and bladder being perfectly sound. When, therefore, bladder symptoms exist, and a careful examination fails to discover any disease in the bladder or urethra, it may fairly be assumed that some renal affection is the cause. But a careful chemical and microscopical examination of the urine is alone sufficient to enable the surgeon to arrive at anything like a correct diagnosis.

Irritability of bladder may also be produced by some cerebral or spinal disease, but the fact can merely be alluded to in these pages.

The passage of a large quantity of urine, as in diabetes, should not be mistaken for irritability of bladder.

INFLAMMATION OF THE BLADDER.

Cystitis is a common consequence of stone, prostatic disease, stricture, or gonorrhœa, and is usually *chronic* or *subacute*—the more acute symptoms mostly supervening upon the chronic. As an *acute* idiopathic disease it has been described by authors, but clinically such cases are very rare. The most acute are those occurring in gouty subjects as a catarrhal affection.

The *chronic* form is the direct consequence of local irritation produced by the presence of a tumor, stone, or other foreign body; although it is found wherever the flow of urine is interfered with from either prostatic disease or urethral obstruction; the bladder in these cases being irritated by the retained and decomposed urine as well as its own ineffectual attempts to evacuate its contents. A similar result likewise ensues when the bladder is paralyzed from over-distension, spinal injury, or disease, and is unable to expel its contents, and under these circumstances the more acute forms of the disease and the worst pathological conditions are found.

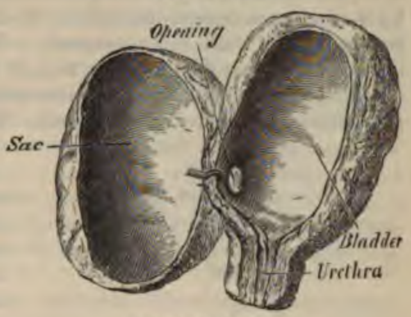
Subacute cystitis is commonly the result of gonorrhœa, the inflammation of the urethra spreading to the bladder.

The seat of the inflammation is the mucous membrane, which becomes rough, covered with flakes of adherent lymph and phosphatic secretion, thickened, and at times ulcerated, and, in the acute forms of the affection, detached in fragments or as a whole, and thrown off as a slough. This latter condition is generally met with in the bladder of the paralytic, and is probably as much due to the deficiency of nerve supply as to the intensity of the inflammatory mischief, rough catheterism having often too much to do with it.

In chronic cases, the walls of the bladder become greatly hypertrophied from overaction, thick muscular bands being visible, and, where the obstruction to the exit of the urine has been of long standing, this thickening of the walls of the bladder is associated with its dilatation. Under these circumstances, it is common to meet with saccular dilatations of the mucous membrane, the mucous lining of the bladder becoming pressed outwards as a hernia between the bands of muscular tissue forming the walls of the organ.

These pouches are usually small, though in exceptional cases (as seen in Fig. 320) they may be double the size of the bladder itself. Into one of these pouches a stone may occasionally fall and rest, thereby becoming encysted. At times these sacculi are multiple.

Fig. 320.



Sacculated bladder.
Prep. 2087^{15}, Guy's Hosp. Mus.

Symptoms.—When the disease is subacute, the symptoms are irritability of bladder and inability to retain urine, the desire to pass water being often associated with its uncontrollable passage. The act of micturition is attended with pain, and followed by straining, blood being frequently squeezed out by the forcible contraction of the organ. Pain is mostly present above the pubes, in the perineum and penis, often over the sacrum and in the groin. With these local symptoms, there may be those of more or less severe febrile disturbance.

The urine will be found to vary in character according to the cause of the disease. When it has originated from the extension of a gonorrhœal inflammation of the urethra, it will be cloudy from the presence of mucus, or even of pus, and at times stained with blood, this blood having been passed during the act of straining at the end of micturition.

In other cases of chronic disease (*catarrhal cystitis*), the urine will be mixed with grayish, viscid, ropy mucus, or muco-purulent fluid, which so sticks to the bottom of the chamber vessel and together as to fall like a glutinous mass when turned out. The urine will probably, in chronic cases, be alkaline or ammoniacal; in subacute, acid; in neglected cases, the discharge of mucus becomes enormous, and phosphate of lime often becomes mixed with the mucus and forms stone.

When ulceration of the bladder is present all the symptoms are aggravated and the local pain severe. Bleeding is a common accompaniment, the blood being either mixed with the contents of the bladder and passed as dark-colored urine, or as clots of blood.

In the cystitis of gonorrhœa, it is probable that the mucous membrane about the neck of the bladder is alone affected; in the more chronic cases of disease, the whole surface and submucous tissue is involved.

Treatment.—Whatever may be the local cause of the cystitis, the local symptoms require attention, although in order to a cure the removal of the cause is most essential.

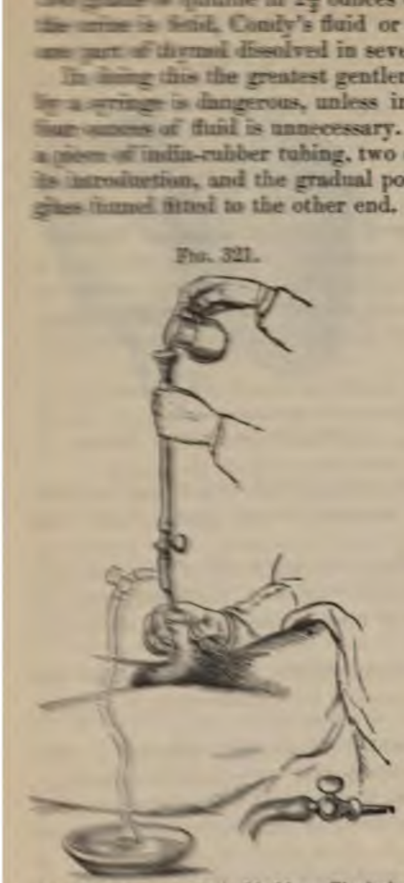
Rest in the horizontal posture, hot fomentations or the hot bath, simple diluents such as barley water, linseed tea, milk and water, with alkalies as the citrate of potash in scruple doses, or the bicarbonate of potash in ten-grain doses, three times a day, and, above all, sedatives, are most essential. Of the sedatives, hyoscyamus is the best in half-drachm or drachm doses of the tincture every two or three hours, and where this is not enough, opium may be substituted; but where the kidneys are diseased, opium should always be given with great caution. The morphia suppository is an excellent remedy, or an enema of starch with opium. The bowels should be relieved by enemata in preference to purgatives, although, when severe constipation is present, a good mercurial purge is often of value; leeches to the perineum are sometimes serviceable.

When retention of urine complicates the case, catheterism is called for and an elastic catheter should be used with the utmost gentleness.

In chronic cases the infusions of buchu, uva ursi, pareira, or senega, are excellent remedies, the tincture of cubebs or copaiba at times acts also beneficially; the triticum repens, as introduced by Sir H. Thompson in the form of a decoction, two ounces to the pint, is also a valuable drug. When gout is the assignable cause, colchicum sometimes acts as a charm, and in some cases of gonorrhœal cystitis, the same good effect is often experienced. The best way is to give it with five-grain doses of the carbonate of lithia. When stone is the cause, it should be removed; when stricture coexists it must be dilated; when enlarged prostate or atony of the bladder in the aged is the cause of the cystitis it is essential to keep the bladder empty and prevent any residual urine from remaining to decompose, and so add to the irritation; for this purpose the catheter should be introduced daily, and in severe cases the bladder should be washed out, either by a stream of tepid water or medicated solution. Ten minims of diluted nitric acid to five ounces of water is the best form, or the same quantity of the tincture of iron. Mr. R. White, of Dublin, speaks highly of borax gr. iv to eight ounces of water, and T. W. Nunn of a solution of two grains of quinine in 2½ ounces of water with a drop of diluted sulphuric acid. When the urine is fetid, Condy's fluid or a few drops of tincture of iodine, carbolic acid, or of one part of thymol dissolved in seven of glycerine may be added to the water.

In doing this the greatest gentleness should be observed; to force fluid into the bladder by a syringe is dangerous, unless in skilled hands, while to introduce more than three or four ounces of fluid is unnecessary. The best method is by means of the irrigator can or a piece of india-rubber tubing, two or three feet long, fitted to the top of the catheter after its introduction, and the gradual pouring of the water or solution made warm through a glass funnel fitted to the other end. The tubing can be raised to increase the pressure of the fluid, or depressed according to the necessities of the case, the bladder resenting the slightest distension by its contraction, and the expulsion or elevation of the fluid into the funnel. By these means no harm can possibly accrue to an inflamed bladder, and the most atonic bladder can be emptied as with a syphon. (Fig. 321.)

Fig. 321.



Mode of washing out the bladder. The irrigator can may be substituted for the jug and funnel.

After the fluid has been introduced and left for two or three minutes, it should be withdrawn, and fresh fluid poured in where necessary, the funnel being depressed below the level of the bed for emptying the bladder. Anodyne solutions are said not to be of much use in these cases, but I have been in the habit of introducing half a grain, more or less, of morphia, with apparent advantage, after the washing out of the bladder. When the washing out of the bladder increases the irritation it should be discontinued. At times a double catheter is of use, the injection flowing down one side, and the contents of the bladder out of the other.

In the inflamed bladder associated with atony, the tincture of the perchloride of iron is a valuable drug, or the dilute nitro-muriatic acid given in twenty-minim or half drachm doses three times a day; but, in a general way, alkalies are called for, the urine naturally secreted being acid, and so as it is poured into the inflamed bladder becomes an irritant. The diet under all circumstances, should be nutritious but unstimulating, alcohol being given carefully, according to the patient's powers. In all cases, however, of inflamed bladder, the surgeon ought to remember its cause, which is generally due to some obstruction to the flow of urine or local cause of irritation; and for a cure, the removal of its cause is essential.

Ulceration of the Bladder.

This is rarely the result of ordinary cystitis, though it may occur in the paralyzed organ, and is met with after death where catheterism has been frequently employed, and in cases of stone. It is likewise found in tuberculous subjects from the breaking down of tuberculous material, as well as in cancer. The disease is indicated by the same symptoms as exist in inflamed bladder, with more local distress, more blood in the urine, and greater pain after micturition. There is usually also much constitutional depression and want of power. I have seen two cases in which extravasation of urine above the pubes resulted from this disease, one of which recovered and the other died.

The indications for treatment are similar to those for cystitis, opium being freely used as a suppository or an enema. All mechanical interference should be avoided unless absolutely called for, and then it should be of the gentlest kind. It is a question, however, whether, in the severe forms, an incision into the bladder, as for lithotomy, would not be a sound practice, the urine then would flow away as secreted, and a chance given to the bladder to recover itself; at any rate, the operation would give relief. I have done this on several occasions with success.

VESICO-INTESTINAL FISTULA.

This is sometimes met with, and it is probable in the majority of cases that the ulcerating process commences in the bowel and involves the bladder in a secondary way. It usually first manifests its presence by the passage of wind with the water, some little irritability of bladder having previously existed; feces, liquid or solid, soon follow, giving rise to fetid urine and severe bladder symptoms, the pain of foreign material in the bladder being very marked when the large intestine or rectum is involved; the liquid motion of the small intestine does not appear to give rise to the same local distress as the solid.

There is no difficulty in recognizing this mixture of urine and intestinal contents. When flatus passes per urethram the condition may be suspected; when the urine has a fecal odor and color the condition gives rise to something more than a suspicion; and when solid feces are visible the diagnosis is certain. In doubtful cases the microscopical examination of the sediment of the urine will readily reveal its nature. At times the feces may obstruct the urethra and cause retention.

In looking into the history of these cases there will usually be found some bowel symptoms, some diarrhœa or dysenteric affection, some symptoms of stricture or cancer of the bowel; and, although this affection may be found associated with cancerous disease, it seems more frequently to be the result of the simple perforating ulcer of the bowel.

TREATMENT.—When a fecal fistula has once formed between the bowel and bladder, the hopes of an unaided natural cure are very feeble, and, when solid motions mix with the urine, but little can be done to palliate the suffering that is produced. For a time the bladder may be emptied of its contents, and, by being washed out, freed of its local irritant; but the truce can be only for a limited period, another action of the bowel being to a certainty followed by a fresh entry of feculent material into the bladder with all its evil effects.

When liquid motions or small intestine contents communicate with the bladder the symptoms are not nearly so distressing, and the necessity for interference is thereby diminished.

The only means the surgeon has at his disposal by which relief can be afforded is colotomy; and, when the rectum is the seat of the disease, whether cancerous or otherwise, lumbar colotomy ought to be performed. By it the feces are diverted from their unnatural channel and discharged through the loin, and all the miseries of bladder complication are effectually relieved. When the ulceration is of a simple kind, there is some prospect of its closing; when of a cancerous nature, such a result cannot be expected; but, under both circumstances, a large amount of relief is immediately afforded and life prolonged.

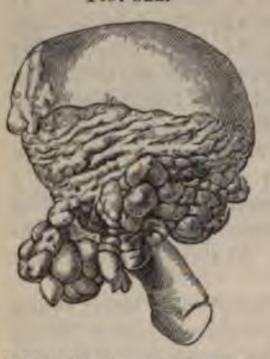
I have had four cases of vesico-intestinal fistula, in which this operation, lumbar colotomy, has been performed with marked success; one lived six years after the operation, and died, æt. 70, from ruptured heart; the second is still alive and well, seven years after the operation; the third died four months after the operation from kidney disease. Mr. Holmes, Mr. C. Heath, and Mr. Pennell, of Rio, have had similar cases. For further information *vide* Holmes's paper, 'Med.-Chir. Trans.' 1866–7; and case, with remarks, by author, 'Brit. and Foreign Quarterly,' Jan. 1869; and 'Clin. Soc. Trans.' 1872.

TUMORS OF THE BLADDER.

These, as met with in practice, may be *warty*, *fibrous*, *villous*, *epithelial*, or *cancerous*. The first three benign growths are usually more or less polypoid and connected with the mucous or submucous tissue of the bladder; the epithelial and cancerous being more infiltrating.

The *warty and fibrous* are most frequently found in children, and give rise to symptoms similar to those of stone and urinary obstruction. They are rarely attended with hemorrhage, differing in this respect widely from all other vesical growths. In the early stage they cause bladder irritation, and in the later, as they approach the urethra, difficult micturition or retention; at times in females, the polypus may protrude through the orifice of the urethra. They cause death usually by obstructing the urinary outlet and inducing organic disease in the bladder and kidneys, suppurative nephritis being a common cause of death. Pathologically they may appear as outgrowths from the mucous and submucous tissue, gradually becoming polypoid, the expulsive action of the bladder, doubtless, having considerable influence in encouraging this result. They are composed of fibro-cellular or fibrous tissue not unlike the polypus of the nose; and occasionally assume more of a warty character. They are sometimes, although rarely, single; generally many pedunculated growths spring from a single base, while sometimes they appear to cover a large surface of the bladder. In Fig. 322 this condition is well seen. It was described by Sir A. Cooper as "Tumor of the mucous membrane of the bladder everted. Polypoid excrescences producing symptoms of stone." Polypoid outgrowths occasionally spring from the prostate gland and give rise to similar symptoms.

FIG. 322.

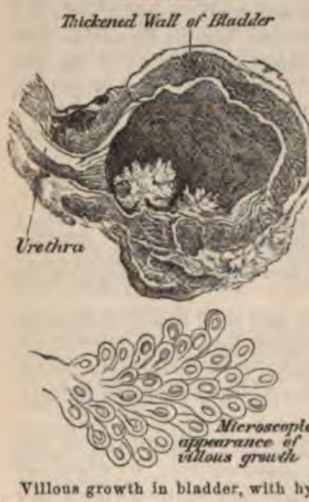


Polypoid outgrowths from mucous membrane of bladder. Preparation 2104^{23}, Guy's Mus.

TREATMENT.—Little more than palliative treatment has hitherto been employed in these cases, as the disease has been little understood and rarely treated. Yet an old surgeon of Guy's, Warner, in 1747, incised the urethra of a woman, æt. 23, who was suffering from a polypus, and put a ligature round the peduncle of a growth the size of a turkey's egg with complete success; and Dessault, after removing a stone from a male, successfully twisted off a polypus that he found in the bladder. Mr. Birkett, in a striking example of the disease occurring in a female child æt. 5, applied a ligature to the growth, but the patient died with suppurating kidney, the effects of the disease ('Med.-Chir. Trans.' 1858); and, on reading the descriptions of other cases, the practicability of successful operative interference does not appear impossible, Richard Volkmann on Nov. 30, 1874, having removed a pedunculated myoma growing from the fundus of the bladder from a man æt. 54, by means of the suprapubic incision—a perineal cut into the bladder having been previously made for diagnostic purposes. The man died from peritonitis the next day ('Arch. 26, Clin.-Chir.' Bd. 10, p. 682). The case, when left to nature, can have but one ending. When the diagnosis can be made with tolerable correctness, an incision into the bladder, as in lithotomy, with the view of applying a ligature to the base of the growth is not even in the male a dangerous operation, and in pedunculated tumors may prove successful; and, when the growth cannot be removed, the operation will doubtless be of value in giving a free opening for urine to escape, and the growth to expand, in this way relieving symptoms. In female subjects the prospects are even more favorable; as when the bladder has been laid open it may be possible to remove the growth by tortion, ligature, or excision, when a cure may ensue, and, if it prove impossible, relief to a certainty will be afforded to all the symptoms as well as life prolonged.

Villous or vascular growths (for these terms are synonymous) are found in the bladder as in any other part of the urinary passages. They grow from the mucous or submucous tissue, and appear as tufts of villous processes like the villi of the chorion. They are usually small in size, and at times multiple, that is, two or three of these tufts are found in the same subject; occasionally, too, the interior of the bladder seems covered with these villous growths. In an example recently under my care this was the case. They are essentially innocent in their nature, and have no relation to cancer as was formerly believed.

FIG. 323.


Thickened Wall of Bladder
Urethra
Microscopic appearance of villous growth

Villous growth in bladder, with hypertrophied walls of the organ. From drawing 368^{61}, Guy's Hosp. Mus.

They possess, moreover, this peculiarity, that they bleed profusely, and even from a single tuft the size of a nut, fatal hemorrhage may occur. They differ widely in this respect from the polypoid tumors last considered, as in these, hematuria is usually the first symptom that attracts notice, and the most persistent; indeed, it is often the only one. If the growth in any way affects the orifice of the urethra, obstruction may exist, but not otherwise. For diagnostic purposes the urine should always be most carefully examined, as it is by no means uncommon for some of the villous tissue to be passed with the water, and then under the microscope its true nature may be revealed. In a case I saw some time ago, with Mr. Dukes, of Canonbury, of a female child who had several attacks of hæmaturia, I caught in the eye of my catheter with which I was examining the bladder, a small villous growth, and accidentally pulled it away. Microscopically its structure was characteristic, and the child had no return of the disease. Fig. 323, taken from a drawing, illustrates one of these growths. Each villus is composed of elongated nucleated cells and loops of blood-vessels, and is covered with columnar epithelium.

TREATMENT.—There is no cure for this affection, and the surgeon can only relieve symptoms; pain and irritability of bladder by sedatives, retention by catheterism employed with extreme gentleness, and hemorrhage by astringents, as gallic acid and iron. Astringent injections have been recommended. The disease usually destroys life in about two years; but a patient of mine died lately who had symptoms of it to a marked degree, with occasional profuse hematuria, for eight years. The whole mucous surface of the bladder was covered with this villous growth, the bladder hypertrophied, and the kidneys diseased as in an ordinary obstructive affection.

Cancer of the bladder is a disease of the old or middle aged, and may occur as a primary disease of the organ, but more commonly from extension of disease from the rectum, uterus, or prostate. It may assume the form of the hard, soft, or epithelial cancer. Hemorrhage is the earliest as it is the most prominent symptom, dysuria and all the other signs and indications of obstructive disease of the urinary passages soon making their appearance. Local pain of a lancinating character is tolerably constant, and is referred much to the loins, thighs, and perineum. The bleeding is often profuse and sudden, blanching the patient; cachexia soon shows itself, and death from exhaustion with glandular enlargements in the pelvis and loins.

The urine often contains *débris* of broken-up cancer with the blood, which when found, render the diagnosis certain; yet the surgeon should remember, that the epithelium of the bladder assumes such variable forms as to compel great caution in coming to any conclusion with regard to the nature of a growth from isolated cells. Masses of cells or organized tissue are valuable diagnostic signs.

TREATMENT.—Here, as in the villous growths, palliative treatment is alone applicable; opium or other sedatives to relieve local pain and give rest being essential. These remedies are most valuable probably as injections into the rectum, or as suppositories. The general powers of the patient should be supported, and everything applied that can give comfort; but no surgical or medical treatment is of any real avail.

Tubercular disease of the bladder.—This is a rare although a real affection, and is confined to young middle age. It is generally associated probably with the same disease of the kidneys or prostate, and shows itself as a deposit of tuberculous matter in the mucous and sub-mucous tissue, which when it breaks down, is an ulcer. It is usually accompanied with symptoms of irritable bladder and painful micturition, the latter symptom being more common when ulceration has taken place.

Rest in the horizontal posture is essential in this as in all bladder affections, anodynes, tonics, and nutritious food being of great value. My friend, Mr. Poland, told me, that in a case of tubercular disease of the bladder attended with ulceration (which was under Mr. Aston Key's care when he was a dresser), where the suffering was severe, Mr. Key suggested the propriety of laying the bladder open, as in lithotomy, and thus allowing the urine to flow off as soon as it reached the bladder. The patient, however, was too far exhausted from advanced lung disease to allow of its performance. Mr. Key stated that, in another case where the disease had not made so much progress, he should not hesitate in peforming the operation. The bladder in this one was found almost stripped of its mucous membrane, and what remained was studded with tubercular deposits. Mr. Key called it phthisis of the bladder.

Atony of the bladder is a want of muscular power in the bladder to expel its contents as a result of its over-distension from either compulsory retention, or organic obstruction, some cerebral disturbance or fever, &c. It has been often falsely described as paralysis of the bladder, but, whereas in paralysis the loss of power is due to a want of nerve supply, in atony it is the result of want of muscular power due to exhaustion or over-stretching. It may be associated with retention or with incontinence, the latter condition showing itself when the bladder is over-charged, the dribbling of urine being a mere overflow.

TREATMENT.—As the cause of atony of the bladder is muscular exhaustion, so the treatment consists in giving the organ muscular repose, which can be done by catheterism. Where the atony is not very complete, the drawing off of the urine twice a day may suffice to allow the organ to recover its tone, and to act naturally. But when the atony is extreme, it may be necessary to introduce a catheter into the bladder and to fasten it there, the urine being allowed to run away as secreted through a tube fixed on the end of the catheter. By this means the most complete rest can be given to the organ. Where the bladder is sluggish in resuming its functions, tonics such as iron may be given, with the local injection into the bladder of some stimulant, as cold water, diluted nitric acid or tincture of iron in the proportion of four to ten drops to the ounce; but catheterism alone, as a rule, is enough, these cases generally recovering unless the cause has been acting for too long a period. When recovery is slow, an electric shock through the pelvis is often beneficial.

Paralysis of the bladder is a far more serious affection than atony, since the want of power is due to deficiency in nerve supply, which deficiency may be partial or complete. It is met with whenever the spinal cord is injured or diseased, as in brain shocks or disease, in reflected irritation from disease about the rectum, uterus, &c., and after any operation upon these parts. It may be caused also by a severe mental shock, or the general depression from a fever.

Treatment.—The cause of the paralysis in these cases must always have an important influence on the practice of the surgeon, but the necessity of keeping the bladder empty is essential under all circumstances; for this purpose a soft, full size elastic catheter had better be passed two or three times a day, the greatest gentleness being observed in the manipulation. When anything like cystitis is present it should be locally treated by washing out the bladder, &c., as already indicated. To leave a catheter in the bladder is not desirable. When professional aid is not always at hand, a nurse may at times be entrusted with a full-sized vulcanized india-rubber catheter without a stilette, and allowed to pass it; it has simply to be pushed down the penis and can do no harm. In fever cases the plan is a good one.

Hysterical retention is not rarely met with in women, and is difficult to treat. Catheterism is only to be resorted to when necessity compels, hysterical patients usually micturating when the pain of retention calls loudly for relief. The cold douche over the lower part of the abdomen is a good local remedy for the affection, and not too pleasant for the patient to wish for its repetition. Moral treatment is always called for in these cases, and is more needful than surgical interference.

Incontinence of Urine

is met with under two very different conditions. In the one, during sleep, when the will of the patient is in abeyance—the neck of the bladder ceasing to act from want of power, and giving rise to *nocturnal incontinence*. In the other, the incontinence is only *a result of over-distension*, and is a mere overflow. The first form is common in children, the second, in adults. Incontinence, however, both in the child and adult, may be due to bladder irritation from the presence of a stone or other foreign body, and it will then exist during the day rather than at night. It may also follow the operation of lithotomy from injury to the sphincter of the neck of the bladder.

Incontinence in the child is a very troublesome, and often very obstinate affection. It is, notwithstanding, generally curable, and even in very bad cases, as puberty approaches, the symptom disappears, though in exceptional instances, the infirmity continues in after-life. The child is generally brought to the surgeon because he "wets his bed," when too often the history reveals the painful fact that punishment has been severely tried before professional advice was sought; and it is needless to add that by such a process, no cure can be effected. In many instances, the habit is in a measure induced by a want of attention in the parents to take the child up during the long hours of the night.

When the prepuce is very long or adherent, circumcision should be performed.

When the urine is chemically wrong in any of its constituents, remedies must be given to correct the faults, and a limpid watery urine in a child, as in an adult, is always an irritant.

With respect to medicines, the tincture of iron is doubtless the best, and next to it, belladonna, either in the form of the tincture or extract, but in some instances the combination of the two is excellent.

I have tried and been disappointed with full doses of chloral given at bed-time. It acts at times wonderfully well, but at others appears useless. When employed, it should be given on an empty stomach. Tonics are the right medicines, one form often succeeding where another fails; iron, quinine, nux vomica, and zinc being, as a rule, better than belladonna. The tonics by day and a night dose of belladonna have sometimes proved of value.

The bowels should always be attended to, and the presence of worms considered; and it is well to have the bowels relieved at night before going to bed. When the child is not too young, cold baths with or without salt should be used, and every means employed to maintain the general health, although it must be added, that children who labor under this infirmity are rarely feeble and cachectic. The child should be encouraged to sleep on his side in preference to his back, and for this end, a handkerchief with a knot in it may be fastened round the pelvis, the knot being adjusted over the sacrum.

In cases of extreme obstinacy, some surgeons apply a solution of nitrate of silver, ten grains to the ounce, to the neck of the bladder, and it is said with advantage. Others apply mechanical means to prevent the flow of urine, such as an india-rubber ring around the penis, or cover up the urethral or preputial orifice by a layer of collodion. Good reports have been given of these practices. I cannot say that I think well of any such means, and have never adopted them, as they seem wrong in principle.

Nocturnal incontinence in a child generally means atony of the sphincter; while incontinence during the *day* suggests bladder irritation, generally a stone or urethral obstruction.

Incontinence in the adult, as already stated, means, as a rule, over-fulness of the bladder, the real condition being one of retention from some obstructive urethral or prostatic disease, bladder atony, or paralysis. It may, however, be due to stone, or the result of a preceding lithotomy. In women it may be associated with some uterine displacement or disturbance, some urethral disease or injury. In men and women, severe spine disease may cause it. To treat it, the cause must be ascertained, and, as the first means of investigation, the introduction of a catheter is probably a sound practice to follow, since it settles at once the question of retention, and often detects the true cause, thereby giving a clue to the treatment to be adopted, viz., the removal of the cause.

True incontinence, however, is met with in severe cases of general or local paralysis, in functional derangement of the cord from venereal excesses, and still more frequently from self-abuse; such patients often complaining of "inability to stop the flow of urine when commenced." It is, however, seen in old people with prostatic enlargement, the third lobe being enlarged and projecting forward between the lateral lobes, so as to open out the neck of the bladder and render it constantly patent, the incontinence being due to overflow, the result of retention.

In these cases, the use of a urinal is the only remedial means at the surgeon's command, except in those caused by venereal excesses, when tonics, cold bathing, and absolute abstinence from all injurious habits may effect a cure.

DISEASES OF THE PROSTATE.

The diseases of the prostate gland are of importance, placed as it is at the neck of the bladder and the commencement of the urethra, for on the one hand it may suffer as a consequence of urethral disease, and on the other, when diseased, it may give rise to bladder symptoms of considerable severity. Thus, it may inflame or suppurate as a consequence of urethral disease, gonorrhœa or stricture, and mechanically interfering with the flow of urine, cause retention. It may indeed undergo nearly complete destruction from suppuration, the direct consequence of stricture and possibly of extravasation. When enlarged from hypertrophy, stone, cancer, or any other cause, it may mechanically interfere with the flow of urine, and so give rise to bladder symptoms or bladder disease of no slight severity, and it may cause incontinence by the special direction of the growth of one of its lobes.

INFLAMMATION OF THE PROSTATE.

This is usually due to the extension backwards of a gonorrhœal inflammation, or, to the presence of a stricture. It may arise, too, as a complication of cystitis from the irritation of a calculus, the passage of a sound, or the application of caustics. It is also not unknown as an idiopathic affection in gouty subjects, and in those who indulge in sexual excesses.

It is generally ushered in with pain in the perineum and bladder irritation, the act of micturition being attended and followed by pain, and often tenesmus. Defecation ceases to be a painless act and is attended with uneasiness, sometimes with difficulty, and at last with distress. On manipulating the perineum, a deep-seated fulness will be felt, and on passing the finger into the rectum, the prostate will be found enlarged, spongy, and painful; rigors probably will form one of the general symptoms with febrile disturbance, which will vary in severity according to the acuteness of the affection.

If the inflammation advances to abscess, a throbbing pain at the neck of the bladder will be felt, with a constant desire to go to stool, and retention of urine is almost sure to occur.

If left alone, the abscess will probably burst into the urethra and discharge itself externally with immediate and marked relief; while in other cases, it may open into the rectum. It sometimes happens that the abscess is ruptured during the passage of a catheter to relieve retention, or during a rectal examination.

When the disease is *acute*, the local as well as the general symptoms will be severe; but when *chronic*, they will be less marked though not less characteristic.

As a result of acute inflammation, *chronic disease* is often left, as indicated by pain in passing water, irritability of bladder, a thin urethral discharge, cloudy purulent urine, and perineal, pelvic, and anal pain, which is increased on exercise or excitement. There may be at times some little loss of power in emptying the bladder, pain in sexual intercourse, or frequent nocturnal emissions.

TREATMENT.—When the symptoms are acute few remedies give more relief than the application of fifteen or twenty leeches to the perineum, followed by a hot hip bath and the subsequent application of a linseed poultice made with the decoction of poppies or mixed with the extract of opium. A good purge should also be resorted to and alkalies given with sedatives such as morphia or opium, to allay pain.

When retention of urine complicates the case, a catheter must be passed, a catheter coudé being the best, but not before the warm bath and opium have been employed, as the introduction of a catheter under such circumstances is always painful and may do harm. When required, an elastic instrument, which has been well softened and oiled, should be selected. Rest in the horizontal posture should be observed, and liquid diet given.

When an *abscess* has formed, and there is evidence of deep-seated perineal suppuration, an incision in the median line of the perineum should be made; and, indeed, if suppuration has not taken place, the operation, by lessening tension, will be followed by relief to the symptoms.

When the abscess has opened naturally, no surgical interference is usually required, although in exceptional cases where one abscess is followed by another, and the deep parts about the gland instead of undergoing repair are becoming more involved, a perineal incision should be made. When the suppuration is the result of a stricture, and has probably been caused by extravasation, the propriety of dividing the stricture and laying open the perineum down to the prostate cannot be questioned.

In chronic inflammation, whether the sequel of the acute or not, when attended with suppuration, the practice already advised should be followed. When no suppuration exists but only enlargement, counter-irritation by means of small perineal blisters is of great use, and the elevation of the pelvis with a pillow at night is also valuable. Tonics, as a rule, are required with the iodide of potassium. The bowels should never be allowed to be confined, the best laxatives being some saline medicine, or one of the natural mineral waters, such as Vichy or Pullna. All mechanical interference with the prostate should be avoided, and the nocturnal emissions treated on general principles, and not as being due to a local cause; tonics, generous living, and fresh air doing more towards hastening recovery than anything else. Over-exercise must be avoided, and sexual excitement forbidden.

Abscesses occasionally occur around the prostate and give rise to very many of the same symptoms as a prostatic abscess They are more apt, however, to make their way towards the posterior part of the perineum into the ischio-rectal fossa. As soon as they are recognized they should be opened by one or two deep incisions in front of the anus on either side of the median line. On one occasion, I let out, by two incisions about a pint of pus that had accumulated in this part, and produced complete retention of urine for several days. Immediate relief and a good recovery followed the operation.

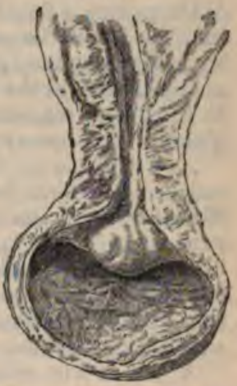
HYPERTROPHY OF THE PROSTATE.

This is a general term applied to a chronic enlargement of the gland which is not inflammatory, but is generally believed to be a common consequence of old age; indeed, it has been regarded as a general senile change. Pathological investigations, however, have taught us that this is not the case, Thompson, with others, having clearly proved that although it is an affection of advanced life, it is in no way a necessary attendant on old age, the vast majority of old men having nothing of the kind.

When present, it is usually met with in subjects over sixty. Thompson has not met with an example under the age of fifty-four; and, after many dissections of the prostates of elderly men, he found an appreciable enlargement of the organ in one-third of the cases, but in only one-third of these was it enough to cause symptoms during life.

The disease is generally believed to be an hypertrophy or over-growth of natural tissues, and, in a certain proportion of instances this is doubtless the case; but in others, the enlargement is clearly caused by the development of distinct glandular tumors embedded within the structure of the gland which may be squeezed out of the organ upon division of the tissues covering them in. They are sometimes merely covered by the capsule of the prostate, while at others, they are well placed within its structure; at times they are single, at others multiple, and rarely give rise to any other than mechanical symptoms. When these growths are situated in what is called the third lobe of the prostate, they give rise to symptoms of obstruction and bladder irritation, precisely similar to those caused by the genuine enlargement or hypertrophy of the gland itself. These fibrous or glandular tumors are analogous to those found in the uterus. This hypertrophy is now known to be, as shown by Ellis and others, a mere increase in the natural fibrous and muscular tissue of the organ with the glandular structure. The enlargement is mostly general, and, as long as the vesical or third lobe is not materially enlarged, nor the urethra encroached upon, it is extraordinary to what a size the prostate may attain without giving rise to any special symptoms. It is indeed only when the so-called third lobe increases bladder-ways, and interferes mechanically with the act of micturition by its size or the direction of its growth, that any marked symptoms are produced. In the preparation from which Fig. 324 was taken this condition is well shown.

FIG. 324.



Enlargement of the third lobe of the prostate.

The effect of an enlargement of the prostate upon the urethra is very variable. At one time the prostatic urethra will be elongated to twice or more its normal length; while at another, it will be tortuous—this condition being caused by an unequal enlargement of the lateral lobes. It is under these circumstances that the diameter of the passage may be encroached upon and obstruction produced. In the bladder, other changes are found, and the sudden projection upwards of the vesical or third lobe is the most common; yet when with this there is an enlargement of one or other of the lateral lobes a great irregularity of the urethra is the result.

This enlargement of the prostate may so derange the course of the muscular fibres about the trigone of the bladder as to produce a bar or ridge that mechanically interferes with micturition. Guthrie and Mercier have described such a bar as occurring independently of these changes, the bar consisting of the elastic structure and mucous membrane of the neck of the bladder. Thompson also asserts that, in "very exceptional instances, the bar is undoubtedly to be met with." I have never known such a bar as that last described, and give it only on the authority of the names quoted. It is said to occur earlier in life than prostatic enlargements, and to give rise to similar symptoms. Hypertrophied prostates are sometimes met with, measuring four inches in diameter, and are common at half that size. They have been found to weigh ten or twelve ounces, the normal weight of the prostate being four and a half drachms.

SYMPTOMS.—So long as the vesical orifice of the urethra is not mechanically encroached upon, prostatic enlargement may proceed to an extreme degree without giving rise to any definite symptoms, and retention of urine is very often the first feature that attracts notice. But, under these circumstances, it generally will be found that the patient has had for some time a difficulty in micturition; that the bladder has hesitated to contract when the desire to pass urine manifested itself; and that either there has been less force in the expulsion of the fluid than formerly, or, that the water has flowed in a more languid stream.

Irritability of the bladder will generally be present, the act of passing urine being rapidly followed by the desire to do so again, and the difficulty of the act gradually increasing.

As the disease progresses, a feeling of weight and fulness in the perineum and of irritation about the rectum will soon appear; the rectal irritation and the irritability of bladder increasing equally, till at last the two acts of defecation and micturition take place together, the violent straining and tenesmus giving rise to prolapse of the rectum or piles, and leading the patient to believe that the bowel complication is the cause of his disease itself.

At a still later period and as the result of the bladder being unable to empty itself, a residuum of urine remains behind, and the bladder consequently gradually expands from its accumulation, and becomes exhausted by its ineffectual expulsive efforts. The urine, moreover, at the same time, decomposes and acts as a direct irritant to the mucous membrane of the bladder. In this way, inflammation of the bladder, and subsequently incontinence from the overflow of a distended organ, is produced, this inconvenience existing day and night.

The ultimate result of this affection left to nature is the same as that of all obstructive urethral diseases; from the pressure of retention the bladder suffers first, and subsequently the ureters and kidneys; organic renal disease is thus set up, and the powers of life are gradually sapped by exhaustion, death being often hastened by severe bladder symptoms, hæmaturia, or uræmic poisoning.

A physical examination of a patient laboring under this disease will probably reveal a bladder more or less distended; and the passage of a catheter even after the patient has to the best of his belief, emptied his bladder, will prove the presence of several ounces of urine which may be ammoniacal; this change in the urine being produced by its partial decomposition from its retention, and admixture with the mucus of the bladder. In neglected cases, the urine will be fetid and may contain blood. The passage of the catheter will also reveal the nature of the obstruction at the neck of the bladder.

On passing a finger into the rectum the enlarged prostate will be felt, and in some cases may nearly fill the pelvis. When pus or fluid exists, fluctuation will be detected, and when inflammation, pain. To make this examination nicely, the finger should be well anointed, and, at the moment of its introduction, the patient should be told to bear down. It should be remembered, however, that to appreciate any abnormal condition of the gland, it is necessary to be familiar with its normal state.

As a consequence of this affection and of the change produced in the urine, a phosphatic calculus may form, but its presence is often masked by the symptoms of the disease. When, however, there is increased pain after micturition, pus and blood in the urine, and extreme pain in the penis, a calculus may be suspected, and, when fragments of phosphatic deposit pass, the suspicion is confirmed. In all long-standing cases of prostatic disease with bladder symptoms, the presence of a stone should be suspected, although when present, it is often difficult of detection from being protected by the enlarged prostate, behind which it usually lies.

A patient with enlarged prostate is liable to retention from any sudden chill, over-distension of the bladder, mental emotion, or fatigue; indeed, such accidents usually reveal the presence of the affection.

TREATMENT.—Medicine has no influence in checking the progress of this disease, nor in causing absorption of the enlarged organ; but surgery can do much in the way of palliating the symptoms that are the direct result of the enlargement, and neutralizing its evil effects.

The most essential point is, to insure the complete evacuation of the bladder's contents, and also to see that no residuum of urine remains in the bladder to irritate the organ and decompose, thereby setting cystitis. This should be done by the passage of a catheter. In early cases where but little bladder irritation exists, the passage of the instrument once a day may suffice; but, when the residual urine is in any quantity and the bladder has lost some of its power of contraction, the introduction of an instrument two or three times in the twenty-four hours may be necessary, and, in worse cases, where the bladder has lost all power of contraction on account of its over-distension from chronic retention, it may be necessary or expedient to tie a catheter in the bladder, and leave it there for a time. The surgeon must remember, too, that instrumental aid, though valuable, is a necessary evil, and should not be resorted to more frequently than the necessities of the case demand.

Where instruments are required, a flexible full-sized catheter is the best. When silver instruments are employed, one with a large curve should be selected, the back of the catheter riding more readily over the enlarged vesicle or third lobe of the prostate than a shorter one. To assist in the introduction of any instrument into the bladder, the passage of the index finger of the surgeon's left hand fully into the rectum is an excellent aid, and, under all circumstances, the pelvis of the patient should be well raised on a pillow.

When an elastic instrument is used and some difficulty experienced in riding over the obstruction, success may often be achieved, as soon as the end of the instrument has reached the vesical end of the urethra, by the withdrawal of the stylet with one hand and the pressure of the catheter into the bladder with the other. Force should never be employed, gentle manipulation and care almost always sufficing to secure success.

When the disease is chronic and the necessity of catheterism is probably permanent, the patient should be taught to pass a gum elastic catheter for himself; a few lessons and a little confidence being all that is required for the purpose.

When the bladder from over-distension has lost all power, and it is necessary that it should have complete rest to allow it time to recover its tone, a catheter may be fastened in, and, if the instrument sets up much bladder irritation, a good compromise may be found in the practice of leaving it in at night and removing it during the day. When the introduction of the instrument is attended with great difficulty, it may be expedient to leave an instrument in for some days, but, under these circumstances, the bladder should be washed out through the catheter daily.

The vulcanized india-rubber catheter is a good form to employ for this purpose, although at times it causes more urethral irritation than the gum elastic. Mr. Holt's winged catheter or any other self-retaining one may be employed when difficulties are experienced with keeping in the simpler form.

When retention is present and catheterism impossible, the surgeon may be called upon to puncture the bladder per rectum in order to give relief. When severe cystitis exists and the agony of catheterism becomes unendurable, a clean incision into the bladder as in lithotomy, to allow the urine to flow away, is a desirable measure.

With the local treatment of this affection, the general must not be neglected, although in importance it is quite secondary. When cystitis exists, it must be treated upon the principles previously laid down. The general condition of the patient must be maintained by means of good diet and sufficient stimulants. The skin should be kept warm and all sudden chills avoided; the bowels kept open, but not loose; pain should be relieved by sedatives and sleep secured by hypnotics; tonics are often called for, the preparations of iron being as a rule the best.

Exercise should be taken when there is no inflammation of the bladder or other reason to forbid it, walking and driving being the best forms, and, under these circumstances, the local distress from the affection may be rendered very light, and life prolonged for many years with comfort.

Patients with this affection should once a day, as a matter of habit, pass urine on their hands and knees; the bladder in this way having more power to evacuate its contents, and the mucus and other more solid contents, which otherwise would lie behind the prostate, are got rid of with greater certainty.

Atrophy of the prostate is often found in the aged and in the young; and in rare cases it is due to some arrest in the development. In the majority, it is genuine atrophy or fibroid degeneration, probably caused in some by syphilis. Such a condition, however, does not give rise to any symptoms by which it can be recognized during life, nor is it a cause of any distress.

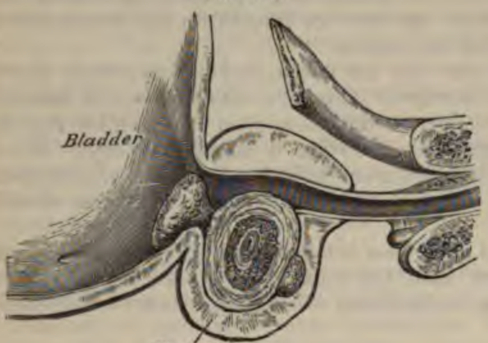
Calculi of the prostate are not rare, and may be found embedded in the organ as small stones varying in size from a grain of sand to bodies of much larger dimensions. They are often very numerous, are sometimes amorphous, but generally laminated. Wollaston says they are composed of 84 per cent. of phosphate of lime, ½ per cent. of carbonate of lime, and 15 per cent. of animal matter.

"The prostate gland, like other glands, is liable to an inspissation of its secretion, producing small yellow, sometimes red, pale or colorless bodies, scattered throughout the follicular structure. These, at first, are said to consist entirely of organic matter, which Virchow believes to be derived from a peculiar insoluble protein substance mixed with the semen; but sooner or later, these formations are believed to irritate the mucous membrane, causing phosphatic depositions, which become encrusted upon the organic matter, and thus the genuine prostatic calculi are found."—*Poland.*

When embedded in the organ and not interfering in any way with the urethra, they cause no symptoms; when encroaching upon the urinary passage, they may cause obstruction, but certainly must give rise to urethral and, probably, bladder irritation. They are accompanied occasionally by ulceration and suppuration of the surrounding parts.

A prostatic calculus may project into the urethra and increase, the urethral portion subsequently extending backwards into the bladder and forming a prostato-vesical calculus. In 'Guy's Hospital Reports' for 1857, a case recorded by Poland, with references to others, will be found (Fig. 325). The calculus has a dumb-bell shape. In all these cases, the urethra is usually pervious; the passage of a sound, however, as a rule, detecting its presence—a grating sensation being experienced in the passage of the metal instrument over the stone, but no ring will be heard. A large prostatic calculus may also be felt per rectum.

FIG. 325.



Prostato-vesical calculus.

TREATMENT.—When a prostatic calculus gives rise to sufficient symptoms to indicate its presence, and by its size is likely to prove troublesome, it should be removed by a perineal section—by such an operation as median lithotomy, the incision stopping short of the bladder, when the stone does not involve it. In this way, Dr. Barker (*vide* Druit's 'Vade Mecum') removed a large stone nearly five inches in diameter with success. When the stone, or stones, give rise to few symptoms of importance, they should be left alone; occasionally they pass naturally per urethram. The greatest argument against operation unless absolutely essential is found in the fact that these calculi are mostly multiple, and often exist in both lobes of the prostate.

Cancer of the prostate occurs but seldom, and is generally of the soft kind; indeed, as Dr. Walshe stated in 1846, "the evidence of the occurrence of true scirrhus of the prostate is defective." The symptoms are those of enlargement, and increase rapidly in severity, the disease being attended with more frequent and profuse hemorrhage than the ordinary hypertrophy. The blood follows the straining which attends the act of micturition, and appears as pure blood; after catheterism it is often profuse. The disease may be primary, but is commonly secondary. It cannot exist for any time without giving rise to glandular enlargements in the groin or along the iliac vessels, when, as a rule, the patient's powers rapidly yield.

The *treatment* is only palliative, the surgeon dealing with symptoms. All instrumental interference should be of the gentlest kind, and as little as possible. Pain must be relieved by opium, and the general powers maintained by good nourishment and stimulants.

Tubercle of the prostate probably, as a rule, only occurs as a part of a general tuberculosis; and until the deposit is breaking up, or by its presence is producing some suppurative action, it gives rise to no symptoms by which it can be recognized. It is too often associated with renal or bladder disease, and the local prostatic mischief is lost in the more general affection. It is quite possible that some of the cases of so-called idiopathic abscess of the prostate are the result of the breaking down of this deposit, but there are no clinical data to enable the surgeon to diagnose the presence of this disease, and there are, consequently, none other than general rules of treatment to be mentioned.

CHAPTER XXII.

STONE IN THE BLADDER AND ITS TREATMENT.

BEFORE passing to the subject of stone in the bladder, it appears desirable to consider, though briefly, that of urinary deposits, organic and inorganic; as the value of a sound knowledge of what the urine may contain, either in *suspension*, *solution*, or *precipitation*, is as great to the surgeon as to the physician, and as indispensable for successful practice.

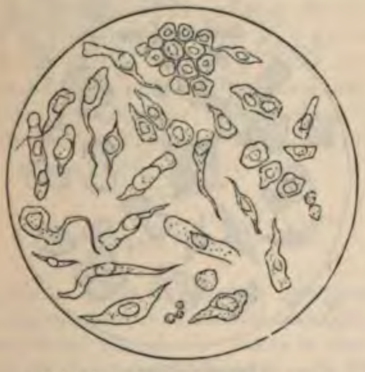
The student should remember that healthy urine is a clear, acid, amber-color fluid, with a specific gravity of 1020 to 1030; that in 1000 parts, 954·81 consist of water, 45·19 of solid matters. These solid matters are made up as follows: urea, 21·57; uric acid, 0·36; extractives, such as creatine, creatinine, xanthine, hippuric acid, ammonia, sarcine, pigment, unoxidized sulphur, phosphorus, mucus, &c., 6·53; chlorine, 4·57; sulphuric acid, 1·31; phosphoric acid, 2·09; potash, 1·40; soda, 7·19; lime, 0·11; magnesia, 0·12. He should further remember that, after drinking, or after a meal, the urine is altered by the nature of the diet and probably diluted; and that the best sample of urine to examine is that passed in the morning before breakfast—the "urina sanguinis" of Prout; when this urine contains any ingredient in excess or in deposit, some important derangement of the system exists. When any of the constituents of the urine are in excess, the balance which normally exists between them, and that keeps them in solution is disturbed, and, as a consequence, some deposit takes place. When this excess consists of the *saline* matter of the urine such as those of potash or soda, urinary deposits and stone are less liable to form on account of their solubility than when the excess is found in the alkaline earths, for the salts of lime and magnesia are most insoluble, and consequently, when in excess, soon show themselves as gravel or calculi. For the same reason, uric acid being very sparingly soluble, is a very common urinary deposit, and is a constituent of most stones. When blood or pus is found in the urine, the surgeon has to discover its source. Is the origin of the blood urethral, prostatic, vesical, or renal? Has the pus been secreted by the bladder, or been poured into it from the kidneys or other part of the urinary tract? Is the salt the result of some excessive supply of its chemical constituents, some deficiency in the working power of the machinery of the body, or some accidental circumstance? Are the kidneys themselves at fault? or, is it that they are called upon to excrete morbid products which have accumulated in the blood from organic or functional disturbance of other portions of the body upon which the existence of healthy blood depends? All these points have to be determined in dealing with any case of urinary deposit; and in the special works devoted to the subject can be found all that is necessary to guide the student.

What I seek to impress here is, that urinary deposits are not themselves diseases, nor to be dealt with as such. They are always to be accepted as indications of disease, functional or organic, in some of the working organs or other parts of the machinery of the body.

The reader is referred for all special information on these points to the works of Bird, Beale, Owen Rees, Bence Jones, William Roberts, Thudichum, Vogel, and Hassall.

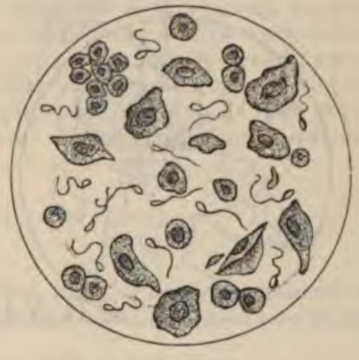
Healthy urine ought to be quite clear. It may, however, be slightly hazy from mucus or from the deposition of urates in cold weather without being abnormal. When any deposit has been merely suspended in the urine, it will commence subsiding as soon as the urine has passed. These deposits are mostly organic, and derived from the kidneys themselves or urinary passages. They may consist of *epithelium*-cells, columnar or tesselated, from those parts, with more or less mucus. (*Vide* Fig. 326.)

Fig. 326.



Epithelium from urinary passages.

Fig. 327.



Spermatozoa and vaginal epithelium.

Blood-corpuscles or *clots*, crystals of hæmatin, or *pus-cells*, may be found.

Renal casts.—Waxy, granular, oily, bloody, or purulent. (Fig. 328.)

The urine under all these circumstances is albuminous, and the best test for albumen is, by boiling and the addition of nitric acid. At times the *débris* of *kidney structure* or *cancer* products may be found.

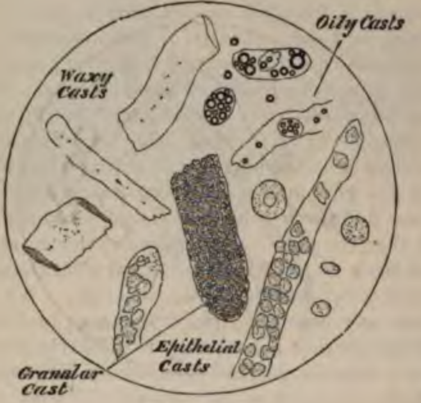
Spermatozoa (Fig. 327), sarcinæ, or hydatids may, likewise, be present. All these materials can be made out only by the microscope.

Urine containing *blood* is either *red* or *smoky;* that containing *bile*, dark or olive brown. *Black* urine is commonly the result of the poisonous absorption of carbolic acid.

Pus, when poured into the urinary passage, has usually little mucus with it; th secreted by the bladder is greatly mixed with it. Purulent urine is always albumino

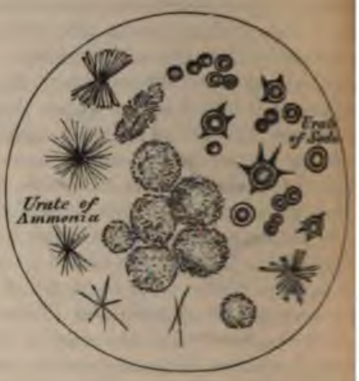
The *urates* generally appear as "brick dust" or "red gravel" deposits. When they so, as soon as the urine has cooled down, there is generally some diminution in the wa constituents of the urine with febrile disturbance. When they are deposited some ho

FIG. 328.



Urinary casts.

FIG. 329.

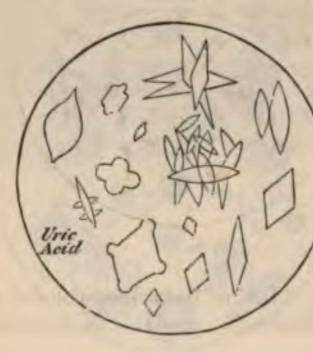


Urates.

after micturition, increased acidity of the urine is indicated from changes in the pig or extractives, the acids being probably the lactic, acetic, and butyric. A drop of added to such urine will cause the settlement of the deposit (Fig. 329). Urates are solved by heat and alkalies.

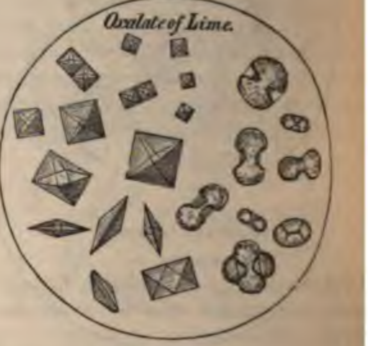
Uric acid appears in transparent urine of a yellow color, and is usually depos slowly. The crystals are variously formed, and chiefly rhombic, with the angles roun off or lozenge-shaped. (Fig. 330.) They are soluble in potash or soda, but insolubl mineral acids.

FIG. 330.



Uric acid.

FIG. 331.



Oxalate of lime.

Oxalate of lime is probably secreted under the same circumstances as the uric and has the same pathological signification. Dr. Parkes holds this view, and beli that it may be a substitution for the excretion of the carbonic acid of the lungs. appears as octohedral crystals or dumb-bell like bodies (Fig. 331), which are insolub acetic acid and alkalies, though soluble in the mineral acids, such as the nitric, wi effervescence.

The phosphates appear as the ammoniaco-magnesian phosphate, the phosph magnesia, and the phosphate of lime.

The first occurs in the form of beautiful, colorless, transparent prisms, or in folia or stellar prisms. It is supposed to be deposited as a consequence of the decompo of urea, and is first seen upon the surface of the urine as an iridescent pedicle (Fig. 332).

It is soluble in acetic acid, but not by heat.

The phosphates of magnesia and lime occur as white gravel, usually amorphous, at times crystalline. They are mostly found in alkaline urine mixed with pus or mucus (Fig. 333). They are insoluble by heat, but soluble in acetic or the mineral acids.

FIG. 332.

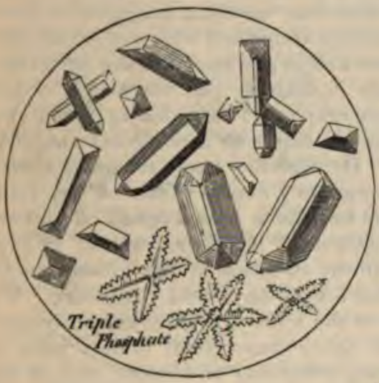
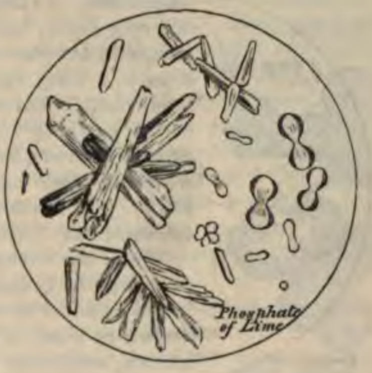


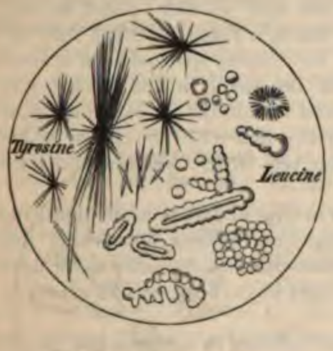
FIG. 333.



Phosphates.

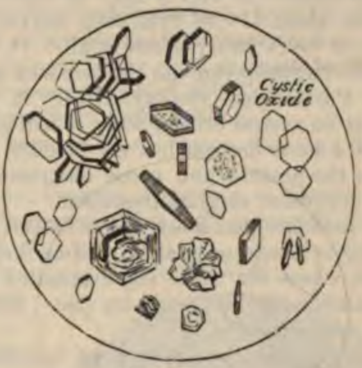
Tyrosine appears in the form of fine needles or stars of a greenish yellow color (Fig. 334). When treated with nitric acid, urine containing it becomes of a deep orange color, and, on evaporation, of deep yellow. A solution of soda dropped upon this flake produces a red tinge.

FIG. 334.



Tyrosine and Leucine.

FIG. 335.



Cystine.

Cystine occurs in colorless hexagonal plates (Fig. 335), or light fawn-colored amorphous deposit, and is soluble in ammonia and hydrochloric acid, insoluble in acetic acid.

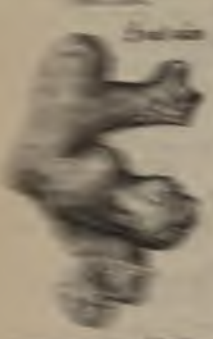
Heat dissolves only the urates of the urine.

Potash dissolves all deposits except the phosphates and oxalate of lime.

Hydrochloric acid dissolves all except uric acid.

When any of the inorganic deposits just described mass together either by themselves upon any nucleus of organic matter such as blood or a foreign body, a stone is the result. This stone may form in the kidney and remain there; it may pass into the bladder and be emitted with the urine, or rest there and increase; or, the calculus may have its origin in the bladder either from the precipitation of the earthy constituents of the urine, or from the irritation of a foreign body introduced from without. A stone having a renal origin and resting in the bladder seems to have the power of extracting from the urine its inorganic elements, and thus rapidly increasing; oxalate of lime, urate of ammonia, uric acid, phosphate of lime, or triple phosphate, being precipitated by its presence, and aggregating or crystallizing upon its surface. It acts, too, after a time, as a foreign [illegible] bladder irritation, and, as a consequence, the phosphatic salts are [illegible] decomposition of the urine. Dr. Owen Rees has shown in his [illegible] 1856, that where irritation of the bladder exists either from a cal[illegible] or other cause, the mucous membrane secretes an alkaline fluid that [illegible] precipitation of the earthy phosphates, and the formation of a phosphatic [illegible] calculus.

[illegible] are generally composed of uric acid, urate of ammonia, or oxalate of [illegible] that microscopic renal calculi of phosphate of lime are by no means uncommon. These concretions may be either impacted in the uriniferous ducts, lodged in pouches connected with the ducts and in[illegible] in the structure of the kidney, or pass into the pelvis of the kidney. They may be single or multiple and the size of a hempseed, nut, or walnut, or, they may be so moulded to the divisions of the pelvis of the organ as to assume an arborescent shape such as that figured (Fig. 336). Dr. Gee has lately recorded a case in which a renal calculus weighed 36¼ ounces ('Med.-Chir. Trans.,' 1874). There is reason also to believe that a renal, like a vesical calculus, may form upon a nucleus of blood the result of an injury.


[illegible]

When the stone is fixed in the structure of the kidney, its presence may be indicated by but few, if any, local symptoms. When it moves about in the pelvis of the kidney, it gives rise to symptoms known as those of *nephritic colic;* paroxysmal lumbar pain, with nausea, vomiting, or collapse, irritability of bladder, and at times painful micturition and hæmaturia being the chief symptoms.

When the stone passes into the ureter all these are aggravated, [illegible] the groin, thigh, and scrotum of the affected side, with retraction of [illegible] continue till the stone reaches the bladder, when a sudden relief is [illegible]

[illegible] in the kidney and increase in size, inflammation, suppuration, [illegible] destruction of the kidney, may ensue; although it is remarkable to [illegible] may be destroyed without giving rise to any symptoms. On [illegible] symptoms may appear for a time and subside, either to reappear [illegible] or not at all. In exceptional cases, a renal calculus may be dis[illegible] through the loin with suppuration; Dr. Cayley showed such a specimen [illegible] Society, 1874. A stone may be impacted in the ureter, and not [illegible] when it will give rise to renal symptoms by obstruction, &c. [illegible] the bladder, it may be discharged with the urine or become [illegible] cause obstruction; or, it may rest in the bladder and increase, [illegible] surgical treatment.

[illegible] vesical calculi have a renal origin, and that some small nucleus [illegible] of lime forms in the kidney and passes downwards into the [illegible] supersaturated with these constituents deposits them upon the [illegible] its size. Stones thus formed have been called *primary cal-* [illegible]

[illegible] has been introduced into the bladder, or a stone has descended [illegible] bladder irritation or cystitis, the phosphatic salts of the urine are [illegible] and stones thus formed are, therefore, phosphatic. When urine [illegible] and decomposes, either as a consequence of cystitis following [illegible] urethra, or a new growth, its earthy constituents are thrown [illegible] or concretions are formed, such deposits being known as [illegible] How far these latter may increase so as to form stones [illegible]

[illegible] however, require to be held together by a kind of [illegible] it to the mucous secretion of the bladder; Fourcroy and [illegible] sometimes to gelatine with an admixture of urea; Berzelius, [illegible] whether it was composed of fibrin, albumen, gaseous matter, [illegible] it to consist of a mixture of gelatine with urea; Scharling [illegible] are always enveloped by a layer of mucus, albumen, or some [illegible] of which entangle and ultimately determine the crystal[illegible] ingredients of the urine; and Dr. Hoskins, as quoted by [illegible] minutest particle of the concretion."—*Coulson.*

[illegible] may be arranged like the deposits, into two distinct classes. The *first* will include calculi of *uric acid* and the urates, with their modifications, the oxalates, *xanthic* and cystic oxide (Dr. G. O. Rees regarding the oxalate of lime as uric acid or urates, altered after secretion); the *second*, the phosphatic calculi. A *third* class may be added, consisting of the rare calculi of carbonate of lime, the fibrinous, the uro-stealith, and the siliceous formations, other chemical ingredients being present, such as organic matters, carbonate of magnesia, silica, oxide of iron, benzoate of ammonia, oxalate of ammonia, phosphate of iron, urea, &c. The oxalates are the heaviest stones, the phosphates the lightest and largest; few exceed an ounce in weight. Coulson records one, however, over six pounds. Recent calculi contain moisture, and consequently are heavier than old. Stones vary in shape according to their position. Thus, *renal* calculi are generally irregular, often arborescent; those in the *ureter* elongated, approaching a cylindrical form. *Bladder* calculi, when single, are more ovoid and flattened, when multiple, facetted. The mulberry stone or oxalate is always tuberculated, mostly globular and hard; the uric acid and urate calculi smooth and regular, the phosphatic irregular of odd shapes, and soft. The dumb-bell calculus is usually prostato-vesical or encysted.

The color of a calculus is no good guide to its nature, as all calculi when associated with bladder irritation and ammoniacal urine become covered with a white coating of phosphatic deposit. A stone of uric acid, however, is usually fawn or brown colored, of urate of ammonia cinder-gray, of oxalate of lime brown or blackish-green, of xanthic or uric oxide cinnamon-brown, of cystic oxide a gray-greenish hue.

Phosphatic calculi, as are other forms when covered with a like deposit, are often horribly fetid and ammoniacal. They are too commonly soft and friable.

The *section* of a calculus reveals its structure, and, while some are homogeneous, the majority display concentric layers of different degrees of thickness; exceptional examples displaying fine lines radiating from its centre of a crystalline form which may be seen in the cystine calculus (Fig. 340).

The different layers of a calculus may have the same composition, or differ widely. When the latter, the calculus is known as *alternating;* but any single layer is generally composed of several ingredients. "It is probable," says Odling, "that if a very exact analysis were made, each of the layers of nearly every calculus would be found to contain uric acid, alkaline urates, phosphate of lime, and ammonio-phosphate of magnesia, with or without the other constituents of calculi. Moreover, most calculi contain traces of all the salts naturally existing in the urine, as well as coloring matter, mucus, &c."

Most calculi are divisible into a central portion or *nucleus*, with an outer portion or *body*, and occasionally there is an outside *crust* of phosphate (Fig. 339).

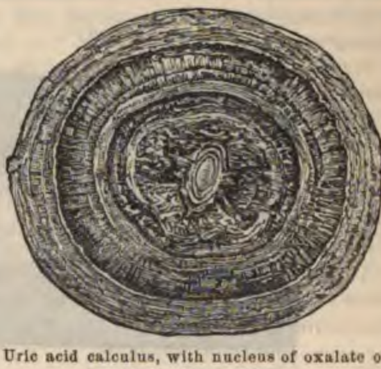
The nucleus may be of the same nature or different from the body.

It may be composed of some organic material, such as blood, mucus, &c., or a foreign body introduced from without (Fig. 341).

1. *Uric acid* calculus is by far the most frequent, forming, according to Cadge, nine-tenths of all primary formations ('Address on Surgery,' 1874). It is usually derived from the kidney, and when retained in the bladder, becomes a flattened oval stone of a fawn or yellow color, with a compact and occasionally crystalline laminated structure (Fig. 337). The uric acid is generally mixed with the alkaline urates in variable proportions.

This form of stone is often found in gouty subjects, and generally in the middle period of life. It is usually associated with acid urine, and such as is prone to deposit the urates. The nuclei of most calculi are of this nature. In the catalogue of calculi of the Royal College of Surgeons of England, plate iv, fig. 6, there is a drawing in which a uric acid calculus is shown to have formed round a piece of steel.

FIG. 337.



Uric acid calculus, with nucleus of oxalate of lime. Prep. 2193.

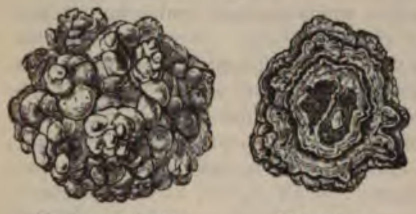
2. The *urate of ammonia* calculus is not common. In Guy's Museum there are only seven specimens of it out of 394 calculi. Most compound calculi contain this substance in abundance. They are seldom large, mostly smooth, and of a gray-fawn color. On section, they are homogeneous or indistinctly laminated and have an earthy fracture. They are more commonly found in children although they have been removed from adults. Guy's Museum contains a bottle (No. 2213) in which are

142 calculi of this nature which Sir A. Cooper removed from the bladder of one pati
They are of the color of pipe-clay, and in the form of cubes with the edges and a
rounded off.

The rarity of this form of calculus is probably due to the solubility of the salts.

3. The *oxalate of lime* or mulberry calculus stands second in point of frequency t
uric acid in European countries; though Dr. H. V. Carter tells us that the oxalate of
ingredient predominates in all urinary calc
Northern India ('St. George's Hospital
ports,' 1871–72) These calculi vary in
from gray to a rich brown or black, and ha
external form of tubercular, angular, or s
character, being rarely perfectly smooth
338). In some, the surface is studded
spines so acute and slender as to resemble t
while in others, there is a coating of acut
hedrons of transparent oxalate of lime, giv
extremely beautiful appearance. Occas
these crystals are opaque and the octohed
flattened when the calculus appears as if studded with pearl-spar (Prep. 2139a,
Museum). The intervals between the spines are sometimes filled with urates or
phates, which give the stone an ovoid form.

Fig. 338.



Mulberry calculus. Its section.

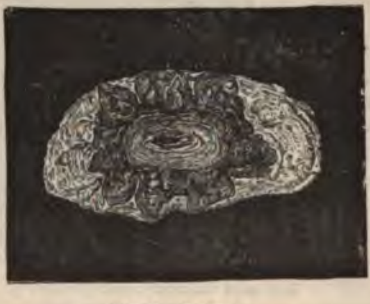
The section of a mulberry calculus is generally that of an imperfectly lamellated
ture, the consecutive layers forming waving lines which often resemble the knotte
of an oak (Fig. 338); but occasionally a layer of oxalate of lime is to be seen ar
around the interior one with great regularity, having a remarkably radiated app
like a series of infinitely minute needles placed side by side, and presenting a pe
porcellaneous structure. In compound calculi the oxalate of lime deposit gives
character of a stone a remarkably beautiful appearance resembling that of fortificatio

The oxalate of lime calculi that have their origin in the kidney (and pass soo
their descent) are usually small, smooth, hemp-seed bodies.

The crystalline mulberry stone is of a pale-brown color, and, according to Dr.
composed of nearly pure oxalate of lime. Poland had a case of this kind in whi
stone on extraction crumbled to pieces from the absence of any binding material of
matter. He gives also, on the authority of Mr. C. Williams, of Norwich, an acc
a pure white oxalate of lime calculus. "This," he says, "is of a milk-white colo
sesses a highly polished surface, is of extreme rarity, and is generally, if not always,
in the kidney; its external surface presents no crystals, but is perfectly smooth, th
may be spinous. In the museum of the Norwich Hospital are three specimens."

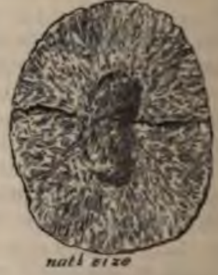
The nucleus of a mulberry stone usually contains uric acid (Fig. 339), while th
is often made up of alternate layers of uric acid and oxalate of lime. The urine is
rally acid. Singular as it may appear, these rough mulberry stones rarely give rise
much bladder irritation as the smoother forms; possibly they roll about less.

Fig. 339.



Mixed calculus.

Fig. 340.



Cystic oxide calculus. Guy's Mus., No.

4. *Cystic* or *cystic oxide* calculus is of rare occurrence, and is a formation of th
ney. Wollaston discovered it in 1810, and the second calculus which he analyzed
Guy's Museum and is about an inch in diameter (Fig. 340), and contains sulphur i
proportions. Poland points out its hereditary nature, since out of 22 collected cas

occurred in four families, and in these the subjects of the complaint were brothers. The calculi are generally rounded or smooth, but may be slightly tuberculated. They have a wax-like lustre, and appear semi-transparent and glistening. When recent, they are of a pale yellowish-brown color, but when kept long assume a pea-green appearance. Dr. Bird remarks upon this point, "It has been suggested to me by Dr. Prout and Dr. Willis that this alteration in tint may in some way depend upon changes produced in the sulphur."

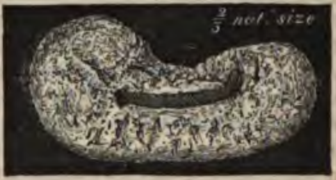
They are soft in consistence, and on section, present a very imperfectly radiated structure with no tendency to a development of concentric layers. They yield easily to the knife when scraped, and form a perfectly white powder, whether the calculus be green or brown. The fracture is crystalline.

5. *Phosphate of lime calculus.*—There are two varieties of this form; *the one* as described by Wollaston of *renal* origin, consisting of neutral phosphate of lime. These usually have a smooth polished surface of a pale-brown color, and are regularly laminated —the laminæ being so slightly adherent as to be easily separable into concentric crusts; in some, lines are seen radiating in a direction perpendicular to the laminæ. These calculi contain a considerable proportion of animal matter.

The other form is of *vesical* origin and composed of phosphate of lime similar to that of bones, and hence often called "bone earth" calculi. They are more common than the former, and constitute irregular masses resembling mortar, or a granular, semi-crystalline powder, enveloped in a tenacious mucus; these latter being more concretious than stones. There are three cases on record in which the phosphatic calculus has been followed by other forms. Foreign bodies, as a rule (and vesical calculi of long standing are such) have the earthy phosphates deposited upon them.

6. *Triple phosphate*, or ammoniaco-magnesian phosphate *calculus* is rare. The College of Surgeons possesses but three specimens, and Guy's only two. No. 2154 in Guy's Museum shows one which has no nucleus, but a central cavity lined with delicate crystals of triple phosphate, resembling the crystals of quartz in the cavities of flints, while No. 2152 is a section of a large calculus of the kind on a nucleus of a tobacco pipe. Fig. 341 represents such a calculus formed round a piece of broken catheter, and occurred in the practice of my friend Dr. Kitchener.

FIG. 341.



Triple phosphate calculus with nucleus of a piece of catheter.

7. The *fusible* calculus, or the phosphate of lime with phosphate of magnesia, and ammonia calculus, is the *most frequent* of the phosphatic calculi. It is generally due to the presence of ammoniacal urine from cystitis, and constitutes the crust that forms on other calculi, or on foreign bodies introduced into the bladder. These calculi increase to a large size, are irregular, and mould themselves to the position in which they are placed, often filling the bladder. Their color is white, gray, or dull yellow, their consistence friable and more earthy than any other variety, sometimes so soft as to resemble moist chalk.

Their appearance on section is thus described by Mr. Taylor in the catalogue of the calculi of the Royal College of Surgeons of England:—"They are frequently composed of concentric laminæ, which in general adhere but slightly to each other; between the laminæ shining crystals of the triple phosphate are often observed; or some of the laminæ are entirely wanting, and these form a white friable mass like chalk; in others, they appear semi-crystalline, as if made up of numerous small crystals confusedly aggregated together. In calculi that have a crystalline and glistening texture the triple phosphate is most abundant, while the calcareous phosphate is in excess in those which have an amorphous earthy appearance."

8. The *carbonate of lime* calculus is a very rare form. Thudichum says that prostatic calculi sometimes consist almost entirely of this substance. In Guy's Museum, No. 2187^{50}, such a vesical stone exists of a snow-white color, with a nucleus of uric acid. Odling says that calculi which have undergone partial decomposition in the bladder often contain this ingredient.

9. The *uric* (of Liebig) or *xanthic oxide* calculus, which bears a close relation to uric acid, is as rare as the last. Dr. Marcet detected the substance in a stone of eight grains' weight, but no remains of it are at Guy's. Stromeyer re-discovered it in a stone weighing 335 grains, removed by Langenbeck, which was laminated, and of a bright brown color. A portion of this calculus is in Guy's Museum, No. 2145^{90}.

10. The *fibrinous calculus* of Marcet and Prout requires notice, although, according to Bird, it must be regarded as a portion of dried inspissated albuminous matter exuded from an irritated kidney. Such pseudo-calculi present considerable lustre and a vitreous fracture.

11. The *uro-stealith calculus* seems to be made up of fatty matter. It has been described in Heller's 'Archives,' 1844–5, and by Moore in the 'Dublin Quart. Journ.' for 1854. In Hunter's collection there is likewise a fine specimen of the kind.

12. *Blood calculi* have likewise been described by Marcet, and Roberts has recorded one taken from a sheep by Mr. Lund, of Manchester. All recorded cases have been connected with renal hæmaturia. Silica, and also the urates of soda and lime, are occasional ingredients in a stone.

With this brief description of the varieties of stones, for much of which I am indebted to Poland's article in 'Holmes's System,' it may be well to consider if any diagnosis of their nature can be made before their removal, and for this purpose the character of the urine is of great value.

If it be *acid* the stone is either uric acid, oxalate of lime, or a mixture of the two; and, as the uric is more common than the oxalate, the probabilities point to the former. When the urine contains either ingredient, the nature of the layer that is being deposited is established.

Gouty people are more prone to uric acid than to oxalate calculi.

If the *urine be alkaline* from *fixed* alkali as indicated by the permanent change in the test paper, the earthy phosphates or the carbonate of lime calculi are indicated; if from the *carbonate of ammonia* the result of decomposition of the urine, the mixed phosphates; that is, a crust of these is being deposited upon an unknown nucleus.

When a small stone has been previously passed and examined, great help is given towards the formation of an opinion, and also when gravel has been passed.

In England, one person in 100,000 dies annually from stone, in Scotland one in 50,000, and in Ireland one in 200,000. The proportion of deaths varies greatly in different districts, Cadge informing us, in his very able address given before the British Med. Assoc. for 1874, that in Norfolk, the mortality from stone is one in about 42,000, and in Cheshire, one in about 425,000.

The bills of mortality indicate, that ten males die to one female from calculous disease, and stone is said to be found in men twenty times more frequently than in women. It is probable, however, that stones form as readily in the one as in the other, but that in women, owing to the shortness of the urethra and its capability of dilatation, they are more readily discharged, large stones not being rarely discharged in the female sex by natural efforts. (*Vide* Stone in Female.) The statistics of M. Civiale, Coulson, and Thompson indicate that about 60 per cent. of the cases of calculi are found in subjects under twenty years of age, 10 or 12 per cent. in those between twenty and forty, 12 to 15 per cent. in those between forty and sixty, and about 10 to 12 per cent. above sixty. But in taking these absolute numbers and comparing them with the relative numbers of persons living at the different periods of life named, it would appear, that children and young persons are less liable to calculous disorders than has been commonly supposed, and that for twenty years and upwards, the tendency goes on increasing in a very remarkable manner to the end of life; or, as Sir H. Thompson puts it, that the "proportion of elderly calculous patients to the existing population at their own ages is larger than the proportion of children afflicted is to the number of existing children."

Two-thirds of the cases of stone that have come under our notice in hospital practice are in children, and half of these are under five years of age. These young ones are, moreover, generally of a healthy and ruddy aspect, and form a contrast to those admitted for other diseases, the formation and presence of a stone in young life being apparently not incompatible with good health.

With respect to the causes of stone I concur, with Cadge, that "it is safer to attribute lithuria to dyspepsia and mal-assimilation, which probably concerns all the digestive organs, than to fix the fault mainly on one," and that this condition arises from the want of milk as an ordinary article of diet, for whilst in the children of the poor, stone in the bladder is so common as to constitute half the whole number of cases met with in practice, it is seldom seen in the more opulent classes.

STONE IN THE BLADDER.

When a stone has descended from the kidney into the bladder it may give rise to no more marked symptom than a slight urinary irritation; and when it passes with the urinary stream this symptom will disappear.

When the calculus rests in the bladder and increases, it usually gives rise to more characteristic symptoms which differ widely in different subjects, and apparently have little to do with the nature of the stone.

In some, indeed, in the majority of cases, the symptoms are so slight as to be disregarded, whilst in the larger number the symptoms have frequently existed for many months if not for years before advice is sought. Indifference or carelessness may occasionally be the cause of this delay, but as a rule, it is due to the uncertainty of the symptoms and the comparatively little inconvenience the patient suffers. It is a rare thing, however, for a parent to seek professional advice for a child suffering with stone until *hæmaturia* has been observed, some prolapse of the rectum taken place, or the *pain* which the child experiences after micturition become pronounced; although in such a case, it will generally, upon inquiry, be learnt that the child for many months had been observed to play with or drag the penis after micturition, that the stream of urine had occasionally been interrupted in its flow, and that a frequent call to make water had long existed.

These symptoms, therefore, with tolerable accuracy denote the presence of a calculus, though its existence can only be affirmed positively on its absolute detection by a sound. Yet nearly all the symptoms which have been enumerated can be produced by other and less important conditions, and more particularly by an elongated and adherent prepuce.

Retention of urine in an otherwise healthy child is almost always caused by the impaction of a stone, and when incontinence exists, it frequently indicates the presence of a calculus which has been forming for a lengthened period, and which is often connected with renal as well as vesical changes of an organic character.

In adult life, indifference to early symptoms is not common, and a frequent desire to pass water when persistent will soon induce a man to seek advice; and as this may be the only symptom of stone, it should neither be disregarded nor lightly treated. Indeed, with such a symptom, a sound should at once be passed, this being the readiest and best means of proving whether a stone be the cause or not. The symptoms that indicate the presence of a calculus will be found to vary, from the slightest irritation of the bladder to the severest agony, and those which have been described will be present in different degrees of severity or in different combinations. The importance, however, of an early detection of a calculus is so great, that in every case of persistently irritable bladder which is not clearly the product of some other affection, it is better to suspect the existence of a stone and examine with a sound than run the slightest risk of overlooking it, and consequently of increasing the dangers (which are always great) of exciting or keeping up organic disease in the bladder and kidney. It is to be remembered that the presence of a calculus is chiefly dangerous to life from the organic renal changes it is liable to excite; and that neither the operation of lithotrity nor lithotomy is commonly fatal if such changes have not taken place. The early detection of a stone becomes, therefore, necessarily a point of the highest importance.

The confirmed symptoms of vesical calculus in the adult are, pain of different degrees of intensity referred to the bladder and aggravated on any sudden movement, such as by riding, jumping, or jolting of the body; pain during and particularly after the act of micturition, extending along the urethra to the penis; exhausting straining, and the passage of blood. During the flow of urine, a sudden arrest of the stream will often be observed, this arrest being followed after the lapse of a moment of time by the return of the flow, and this interruption may be repeated more than once in each act of micturition. Retention or incontinence of urine may complicate the case. Rectal irritation and tenesmus with or without prolapse are also frequent symptoms; and reflected pains along certain nerves are very constant. Thus, pain in the glans penis is most common, and pain in the scrotum, perineum, and down the thighs. John Hunter relates a case of stone in which pain in the left forearm was the only indication of a want to make water. Sometimes the bladder symptoms may be severe for a time and then cease, or suddenly appear after any extra exertion. In the former case, the stone probably becomes fixed in a sacculus and ceases to irritate; in the latter, it escapes from a sacculus and makes its presence known. As long as the bladder remains healthy the changes in the urine will be but slight, but when the stone, acting as a foreign body, sets up cystitis, all the symptoms of that affection will appear, with the muco-purulent discharge and ammoniacal urine.

When the symptoms have existed for any lengthened period, the probabilities of renal complications are great, as indicated by albuminous urine with lumbar pain and anasarca.

In rare cases, a persistent erection of the penis is present.

But these symptoms of stone are merely *subjective;* they are those given by the patient; and, however suggestive of the affection they may be, are not conclusive, since all may be produced by other bladder affections. The only conclusive evidence to be obtained is by the physical examination of the bladder, or by the "sounding" of the patient with a metallic sound or catheter, by the "ringing" of the stone against its end.

To sound a patient suspected of stone, the horizontal position should be selected, and the pelvis raised on a pillow. The bladder should contain a few ounces of urine if possible, three or four being enough and eight being ample, and the rectum should be empty. When the bladder is empty, some few ounces of water should be injected. For a child, a small metallic bulbous catheter or sound with a short sharp curve should be used (Fig. 343), the bulbous end being one size larger than the stem, and for the adult, a similar instrument suffices (Fig. 342).

FIG. 342.

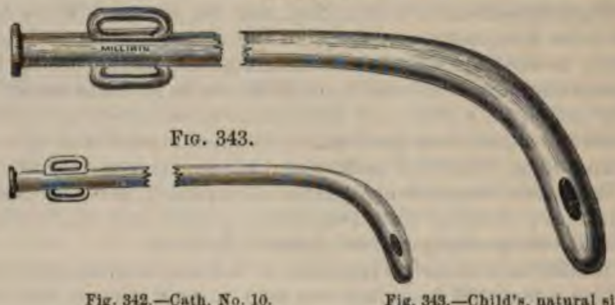


FIG. 343.

Fig. 342.—Cath. No. 10.

Fig. 343.—Child's, natural size.

An instrument with a long curve may glide over the stone, and will certainly fail to find one lodged behind the prostate; it is, also, less movable. The short curved catheter can be made to turn downwards to explore the base of the bladder with the same facility as it can the sides. A hollow sound or catheter is better than a solid, as a stone will often be detected on drawing off the urine, as the bladder in the act of contracting may throw the stone upon the end of the instrument, and thus make its presence known. The catheter should not have a stylet.

The instrument should be warmed, freely oiled, and passed carefully and slowly into the bladder, nor ought its introduction to give pain. It should be at first pushed well home towards the posterior part of the organ to search its base, and then turned first to one side and then to the other to search its sides, the sound during the operation being gradually withdrawn and again pushed back. When an enlarged prostate exists, and a stone is suspected to lie in a pouch behind the so-called gland, the beak of the instrument must be turned backwards, and in this way every corner of the bladder can be examined. When no "ring" of the calculus can be obtained, the water may be partially drawn off, and by this manœuvre success will often be the result. In children, the introduction of a finger into the rectum facilitates at times the search, and the pressure of the hand above the pubes, often facilitates the detection of the stone.

A large stone is generally touched on the sound entering the neck of the bladder, and a small one usually lies at the base of the bladder, either to the right or left of the median line. An encysted stone is a rarity. A stone may often be felt at one time and not at another; consequently, when well-marked symptoms exist any hasty opinion as to its absence is to be avoided. Mr. F. L'Estrange, of Dublin, has invented a sounding-board to be fastened to the top of the sound for intensifying the noise produced by the instrument when it strikes a stone in the bladder. It is an ingenious instrument.

Mr. Napier has invented a pewter sound the surface of which being oxidized by nitric acid is easily scratched when coming in contact with a stone. It seems to be of use when the stone is otherwise difficult of detection. For the same purpose the microphone may possibly prove of value.

The operation of sounding ought to reveal something more, however, than the presence of the stone, such as its size and nature, and whether more than one is present. The size is indicated by the extent of surface passed over by the point of the instrument; and the nature, by the noise emitted on the striking of the stone, such hard stones as the uric acid or oxalate of lime giving a sharp, clear, ringing sound; while the light and soft phosphatic calculi yield a dull one. The roughness of the oxalate of lime calculus may also be generally felt. In children, with the finger in the rectum, the size of the calculus can often be readily made out. The character of the urine, as already pointed out, throws some light upon that of the calculus. The value of chloroform in facilitating the search for a stone, more particularly in children, is so great, that it should almost always be employed. In sounding, the surgeon must not be misled by the sensation given by the rugous or roughened bladder, the viscus feeling hard and uneven to the end of the sound, and the examination giving pain. When this condition is made out all sounding should be given up, for the existence of such with a stone is almost unknown.

In children, the instrument may strike against the sacrum or spine of the ischium and mislead, but in this case there is no sound emitted; indeed, the surgeon must be careful to *hear* as well as to *feel* the stone before he is satisfied as to its presence, as there are many affections of the bladder and prostate that in their clinical history and physical symptoms simulate those of stone, but in none is any perceptible sound given when using the metallic instrument, as in stone. The only unequivocal sign of calculus is the sound produced on striking the stone.

In forming a diagnosis, the surgeon should always remember that when irritation at the neck of the bladder arises from stone, it is referred to the glans penis; when from disease of the bladder, to the organ itself; and when from disease of the prostate, to the perineum or rectum.

When a calculus is suspected in the female, a vaginal examination will often enable the surgeon to feel the foreign body. It will also remove all such sources of fallacy as are prone to follow from uterine affections. In female children, a rectal examination will do as well.

TREATMENT.—A calculus having been detected in the bladder, there is only one form of treatment which can be successful, and that is its removal; for, with rare exceptions, a stone, if allowed to remain, will set up, not only bladder disease, but kidney mischief, ending in death.

A stone may be removed by a cutting operation, *lithotomy;* or by a crushing one, *lithotrity;* the treatment by *lithontriptics* and *electrolysis* has hitherto met with indifferent success.

In former times, small stones were removed from the bladder by forceps. Sir B. Brodie, Sir W. Blizard, Boyer, George Bell, and others, have recorded many such cases. Sir A. Cooper's celebrated case, in which he removed eighty small stones by this means, is well known; but the practice has been entirely superseded by the lithotrite.

Lithontriptics, or stone solvents, were used long before the composition of urinary calculi had been made known, and were mostly alkaline remedies; and the most celebrated nostrum of Joanna Stephens, for which the government of 1739 gave a reward of £5000, was composed of burnt eggshells and snails, with Alicante soap. Prout showed the value of fluid as a solvent in calculous affections; Chevalier, of alkalies; and Ch. Petit, more particularly of the Vichy springs. There can be no little doubt, too, that in the lithic acid form of stone, alkalies have an undeniable influence in checking their increase, if not in aiding their solution. In other stones they have no such influence.

Dr. Roberts, who has in recent years paid much attention to this subject ('Med.-Chir. Trans.,' 1865), seems to think that "the results obtained by his experiments demand a considerable modification of the prevailing opinion regarding the inutility of the solvent treatment; they suggest an essential improvement in the treatment of *renal* calculi; they indicate that uric acid and cystine, under certain circumstances, are capable of solution in the bladder, by means of alkaline salts administered by the mouth, at a rate which admits of practical application; and that in picked cases a solvent treatment deserves to be resolutely tried." He adds, however, "that the solvent treatment is only applicable in those cases of vesical calculi in which the urine is acid, the stone not large, its composition known to be uric acid, or strongly suspected to be such." The best solvents are the acetate or citrate of potash, sufficient doses being given to make the urine *neutral*, not *alkaline*.

Brodie showed that the injection into the bladder of a solution of nitric acid, two or three minims to the ounce of water, had the power of dissolving phosphatic calculi; and, upon this suggestion, other experimenters have tried other fluids, such as weak alkaline solutions for uric acid calculi, carbonate of lithia, borax, and acetate of lead, &c.; but there is this great disadvantage in the practice, that the solutions are apt to irritate the bladder, and thus do more harm than good. In the uric acid and oxalate of lime calculi, they are almost useless. In the phosphatic stones, most surgeons admit the value of the practice, a solution of diluted nitric acid, ʒij to a pint of water, injected into a bladder where phosphates are being deposited, being of great value in many cases. Such a practice must, however, be carried out with great caution.

The aid of the galvanic battery has been employed to break up stones by Dr. Bence Jones, Sir W. O'Shaughnessy, and others; but the success attending the experiments has not been sufficient to warrant the recommendation of the means.

Small stones may often be washed out of the bladder by means of the urine; and patients who are prone to the passage of renal calculi into the bladder, and to the formation of lithic acid or other gravel, should be directed once a day, when the full bladder is about to discharge its contents, to arrest the flow of urine by holding the penis, and then suddenly to allow the stream to flow; in this way the water passing with a rush, carries away any small stone or sand that might be resting in the bladder. I have known this practice to be followed by good success. Old men should do this on their hands and knees. When a stone is too large to pass in this way, it must be removed, which is to be done by means of lithotomy or lithotrity.

Lithotomy or Lithotrity in cases of Stone.

Stone in the bladder in children may safely be treated by lithotomy. It ought to be performed as soon as a stone has been detected in the bladder, for the dangers of any individual case can be fairly measured by the size of the stone and the duration of the symptoms. The longer a calculus has existed, the greater are the probabilities of renal disease complicating the case; and the dangers of lithotomy, independently of its own special risks, are mostly due to the kidney affection. When the stone is large, the neck of the bladder may be so injured as to set up a fatal peritonitis, and hemorrhage may, in exceptional cases, cause death; but in skilful hands, the operation of lithotomy, in patients under puberty, is most successful.

Sir W. Fergusson informs us, in his College Lectures, that out of fifty cases of lithotomy in children, he lost only two. In my own practice, out of upwards of thirty cases under puberty, I have lost but one, and then the patient was ten years old; he had had symptoms all his life, and incontinence of urine for four years. The stone was two ounces in weight, and two inches in diameter. He died with peritonitis and extreme disorganization of the kidney.

In children, therefore, it may be safely asserted that success may with some confidence be looked for after lithotomy, when performed with care and skill. "It may reasonably be doubted if better can be done before fifteen than cutting for stone."—*Fergusson.*

Lithotrity in a child, with fine instruments, may be a justifiable operation in exceptional cases when the calculus is known to be very small; but, as a rule, in patients under puberty, lithotomy ought to be selected. In Great Britain, this practice is generally followed by surgeons; although in France, lithotrity is more frequently selected.

In stone in the bladder in adults, however, no such general rule can be laid down, although it may safely be asserted that, whenever a stone is found in the bladder of a male adult, its removal by lithotrity ought primarily to be entertained, and lithotomy had recourse to only when lithotrity is inapplicable. In tolerably *healthy* subjects, where the stone is small or of moderate dimensions, that is, about one inch in diameter, lithotrity is to be preferred to lithotomy, as the danger of lithotomy rapidly increases with age, the mortality being one in eight between seventeen and forty, one in four above that age. I have cut twenty-four adult male subjects with six deaths, or one in four; and Thompson out of seventy-eight cases lost twenty-nine, or one in two and three-quarters.

"When lithotrity is employed for stones as large as a date or a small chestnut—and it is impossible to deny the excellent chance of success which this method offers to the subjects of such stones—a certain, but still only small proportion, of deaths must be expected; and the rate of mortality will correspond with augumentation in the size of the stones, and with the amount of existing disease and age on the part of the patient. Given a small stone in a fairly healthy person, and success is certain; the possibility of contingency in such a case depending only on the presence of those remote and excessively rare conditions which will make, for an individual here and there, the mere passing of a catheter a cause of death. In an adult subject, with a urethra of good calibre, and not over-irritable—with a prostate of normal size, or, if enlarged, not over-sensitive, or interfering with the passage of the lithotrite—with a bladder fairly healthy, and capable of containing at least four ounces of urine—a moderate stone, and a patient endowed with good health and an ordinary amount of pluck, the operation of lithotrity may be undertaken with every prospect of success." "It is, however, unwise to apply as a rule lithotrity to any stones above moderate size; and, if any calculus is sufficiently large to require what is known as the fenestrated instrument, it is better to employ lithotomy." This is the conclusion of Sir H. Thompson after an experience of 422 cases of lithotrity with thirty-two deaths, or one in thirteen cases. ('Med.-Chir. Trans.,' 1878.)

When *severe* bladder mischief complicates the case, lithotrity is out of the question, and lithotomy should be selected, although experience confirms what C. Hawkins has stated, that lithotrity may be performed with success when the bladder has been in a very considerable state of irritation, and secreting much ropy mucus. The irritation and the secretion of mucus diminish as the operations are performed, and nearly cease before the whole of the calculus has been removed. These cases certainly require much caution in their management; still they are by no means those in which lithotrity is to be rejected.

When renal disease can be made out as existing, lithotrity is no more a favorable operation than lithotomy; when associated with bladder complications, the cutting operation is probably the right one to adopt, even if only as a means of giving relief, although, when the stone is small and the renal symptoms uncertain, lithotrity may be undertaken with success.

When the surgeon, however, on passing an instrument into the bladder finds the urethra narrow and irritable, "the neck of the bladder and mucous membrane particularly sensitive, the prostate somewhat large and so firm in substance that it has been difficult to pass a sharp-curved instrument; the bladder disposed to throw off its fluid contents; the stone large, perhaps more than one, and possibly withal an irritable temperament and a want of moral and physical courage, it is to me," writes Fergusson ('Lect. on Prog. of Surg.,' 1867), "very doubtful if the operation of lithotrity should be resorted to;" although, he adds, "it is remarkable how, in some, these conditions become modified by care and preliminary manipulative treatment."

Paralysis of the bladder does not positively preclude the practice of lithotrity, though it necessitates extra care and gentleness in manipulation, and may require the mechanical removal of the fragments by a scoop or Clover's apparatus. (Fig. 319A.) An enlarged prostate, unless mechanically interfering with the introduction of the instrument, is by no means an insuperable bar to lithotrity.

"Formerly," wrote Aston Key (1837, 'Guy's Reports'), "patients laboring under calculous disorders entertained a feeling of dread, almost amounting to horror, at the idea of having a stone in the bladder. But since the introduction of lithotrity they no longer entertain the dread of their symptoms depending on the presence of a stone, and when the stone is found they cheerfully make up their minds to undergo an operation, which they regard as free from danger, and nearly so from pain. I have known a patient, and more than one, to be pleased with the discovery of a stone in the bladder, convinced, as he expressed it, that he could look for an easy cure from the new operation. The exaggerated statements of the advantages of lithotrity have, thus, not been unattended with good; they have been the means of inducing persons to come forward to obtain relief when the disease was incipient and the stone small. Since the introduction of lithotrity the surgeon examines the bladder with great care, knowing the importance of discovering the calculus at the earliest period. The early symptoms of stone are thus watched with more jealousy on the part of the surgeon, and are not so scrupulously concealed by the patient. The advantages of an early knowledge of the existence of a stone, and of prompt measures for its removal are known to both. The result of this is, that patients apply for advice when the stone is small, the bladder uninjured by its presence, and the kidneys free from disease. In three persons out of four who apply for advice for symptoms of calculus, the size of the stone and the conditions of the viscus render lithotrity an easy and a safe operation."

These extracts which I have given from Aston Key's paper written forty years ago, might have been from the pen of a more recent writer, as they most accurately represent the advantages of what was then called the new operation, and prove how the great surgeon who wrote them recognized its value.

It would thus appear that in *children*, lithotomy ought to be the rule, and lithotrity the exception. In *adults*, lithotrity ought to be the rule and lithotomy the exception—the latter operation being selected only when the former is impossible from some urethral or prostatic irritability or mechanical obstruction, severe bladder disease, or a large stone. Renal disease in all cases renders doubtful the prognosis of any operative procedure, the weight of evidence tending in favor of a cutting rather than a crushing operation under such circumstances, though when the stone is small, lithotrity is not precluded.

In cases in which neither operation can be recommended, or when both are rejected, it is wonderful how long patients, the subjects of stone and organic disease, by care and good advice will live, and how little irritation a calculus sometimes causes; and though the knowledge of this fact should not induce a surgeon to leave alone a patient who has a stone, it is enough to enable him to give hope and encouragement to one whose life would be endangered by any surgical attempt at its removal, for palliative treatment is, doubtless, a source of great comfort and a valuable means of prolonging life.

LITHOTRITY.

"In the whole of my professional experience," says Fergusson in his College Lectures, 1867, "I know not of a useful operation which has been so shamefully overpraised, and thereby damaged in character as lithotrity. I know not any process in surgery requiring more forethought, knowledge, manipulative skill, and after-judgment." "Nor is it possible," writes Thompson, "to conduct all the manipulations with too much care and gentleness." These opinions, emanating as they do from two of the most experienced lithotritists of the present day, ought always to be remembered, since they are true to a degree that surgeons only who have had some experience in the operation can appreciate. To Mr. Elderton, a Northampton surgeon, is due the merit of being the first to construct an instrument for the purpose of crushing a calculus, and enabling the patient to pass it by the urethra ('Edin. Med. and Surg. Journal,' April, 1819); but lithotrity was first realized as an operation and successfully practised by Civiale in 1824, and to him the profession is chiefly indebted for the operation, though Leroy d'Etiolles, Heurteloup, Amussat, and others did much towards favoring the practice. It is probably, however, to Heurteloup that British surgeons are mostly indebted, as he came over to England about 1829 and explained fully to the profession the mechanism of his improved instruments and the steps of the operation, and, on the invitation of Mr. Aston Key, this instruction was given in the theatre of Guy's Hospital. Weiss, in 1823, had previously devised a screw lithotrite, and, after Heurteloup's visit, and probably from information acquired through him, so improved it, that all modern instruments are based upon that which he then introduced. Aston Key, Brodie, Castello, Hodgson, Fergusson, and others, subsequently practised the operation, and, upon the result of their experience with that of Civiale, the operation has become a recognized one, the instruments employed having been vastly improved and their use better understood.

In 1829 Aston Key read a paper on lithotrity at the Hunterian Society, and the report of a successful case, and in 'Guy's Reports' for 1837 will be found a masterly paper upon the subject by the same surgeon. In 1834, Fergusson also wrote on lithotrity in the 'Edin. Med. and Surg. Journal,' in which he introduced his rack lithotrite, and to him as well as to Sir B. Brodie, Sir H. Thompson, and Charles Hawkins, most of our modern improvements are due.

In a former page, the difficult question was briefly discussed as to the class of cases in which lithotrity should be selected, and in this the mode of operation, the preliminary and after-treatment, remain to be explained. For it may safely be stated, that no cases require more careful preparatory treatment and more cautious after-treatment than those now under consideration.

Starting, therefore, with the assumption that our patient is middle-aged and healthy; the stone of moderate dimensions and not too hard; the urethra of normal size; bladder healthy and capable of retaining easily about four or six ounces of urine—conditions under which operative interference ought to be most favorable—it is always well to keep the patient quiet for a few days, and to test the urethra and bladder as to their capabilities of bearing the mechanical irritation of the instrument by the introduction of a sound; attention should be paid at the same time to the condition of the secretions, &c. With every attention, however, it is not uncommon to meet with cases in which the mere passage of a sound is followed by severe local and constitutional disturbance, and in lithotrity, such a complication is most detrimental. On the other hand, where irritability exists, the occasional introduction of an instrument is often followed by relief.

When the bladder is inflamed and irritated by the presence of a stone, rest is most essential, with the use of alkalies and the decoction of the Triticum repens, or other drugs suitable for cystitis. When the urine is ammoniacal, the bladder should be emptied and washed out.

By these means the symptoms may subside and the bladder become capable of retaining sufficient urine—four to six ounces—to allow of the operation being performed, where previously it would have been impossible.

"If a stone be small, and it be possible to make away with it at a single operation, I should not mind advising lithotrity on a very brief acquaintance; but if the operation is likely to require two or more sittings, then I should think it wise of the surgeon to test, as it were, his patient's constitution by a repeated preliminary use of a bougie or sound."—*Fergusson.*

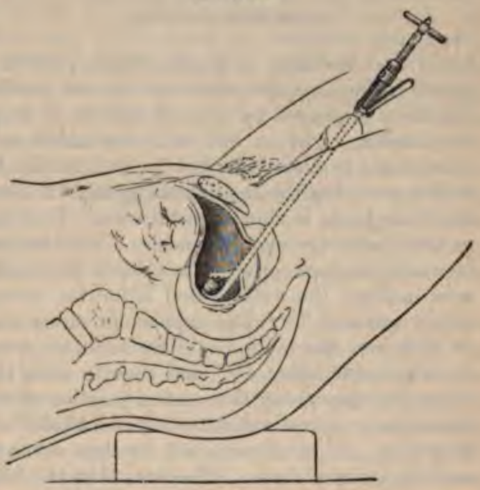
The patient having been prepared for operation by the treatment just laid down, the bowels cleared by a mild aperient or an enema the day before, and the bladder sufficiently distended by the patient retaining his urine as long as he conveniently can before the surgeon's visit, the operation may then be proceeded with.

Operation.—The patient should be placed upon a firm horse-hair mattress or sofa, the pelvis raised by means of a pillow, and the knees slightly raised and separated, care being taken that only such portions of the pelvis are exposed as are necessary to allow ot the surgeon's manipulation, for a sudden chill often acts upon the bladder and induces it to contract and expel its contents.

The instrument, selected by the surgeon, having been previously well warmed and oiled, is then to be carefully introduced, no force being employed, indeed, it may almost be allowed to fall into the bladder by its own weight, the surgeon simply guiding it.

The bladder thus reached and the instrument pressed well into the organ, the object is to seize the stone, which can either be done by so depressing the lithotrite with its open blades as to allow of the stone falling between them, or by turning the open instrument to the stone and picking it up. The *first* is the older and the more usual method, and the one I have commonly adopted, the *second* being useful where the first is inapplicable, where the prostate is enlarged, and the stone rests in a hollow behind it. It grows in favor with experience.

Fig. 344.



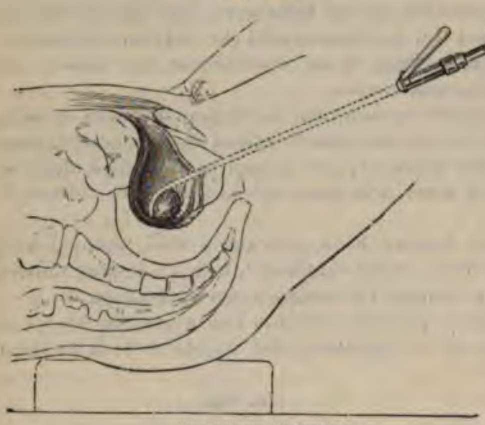
Operation of lithotrity.

I give the *first*, or *English method* (Fig. 344), in Brodie's words: "The rule for seizing the calculus (which I must acknowledge to have first learned from witnessing the very dexterous operations of Heurteloup) is as simple as possible. The patient lying on his back, the handle of the forceps (lithotrite) is elevated, which, of course, brings the convex part of the curved extremity of it in contact with the posterior surface of the bladder, where it is contiguous to the rectum. The forceps is then to be opened by withdrawing the sliding blade to a greater or less extent, according to the probable size of the calculus, the fixed blade being at the same time pressed gently downwards in the direction of the rectum. The object of this manipulation is, that the forceps, being below the level of the other parts of the bladder, the calculus may fall into it by its own weight, and it is generally successful. If it should not do so, the forceps, without being moved from its situation, may be gently struck with the hand on one side, or on its anterior part, and the slight concussion thus communicated to the bladder will probably be sufficient to dislodge the calculus, and bring it within the grasp of the instrument. If it should be otherwise, the forceps, being closed, may be very gently and cautiously turned to one side or the other, so that the curved extremity of it may make an angle of 25° or even 30° with the vertical line of the body, then opened and pressed in the direction of the rectum in the manner already described."

"When the prostate gland is much enlarged there is sometimes a difficulty in seizing the calculus, arising either from it lying under that part of the gland which projects into the bladder or from the impediment which it offers to the elevation of the handle of the instrument. For such cases the operating table invented by Heurteloup, which enables the patient's shoulder to be suddenly lowered, is very convenient; or the same purpose will be answered sufficiently well if the patient be placed on a light sofa, the end of which may be raised by an assistant. The calculus is then seized, not in that part of the bladder which adjoins the rectum, but in the fundus, this being rendered the lowest point by the elevation of the pelvis."

The *second* mode of seizing the stone may be described as that of Civiale (Fig. 345). It is thus given by Sir H. Thompson: "Its principle is the reverse of the preceding. By the position of the patient, *the centre of the bladder and space beneath it are selected as the area of operation;* no depression is made; contact between the walls of the bladder and the instrument is, as much as possible, avoided. The instrument is applied to the stone in the situation which this naturally takes, and the operator carefully avoids moving it, or any movements of concussion whatever, however slight. This improved method is in part due to the mechanical improvements which have been made in the lithotrite of late years. The method was scarcely possible until the present instruments existed."

Fig. 345.



Operation of lithotrity.

"We shall now consider it in detail. The blades having entered the cavity of the bladder, the instrument slides easily and smoothly down the trigone, which in the living and healthy organ is an inclined plane, although quite otherwise in the atonied and in the dead bladder. In many cases the stone is grazed by the instrument as it passes, and the slightest lateral movement of the blades, right or left, will determine on which side it lies. If so, the operator is careful not to disturb it, but he inclines the blades *slightly away from the side on which it lies,* carrying the instrument gently in towards the posterior wall of the bladder, while the male blade is slowly withdrawn. It is important always to bear in mind that as long as the blades are near the neck of the bladder the male blade cannot be withdrawn, since it would impinge on that sensitive part and cause pain or injury. Having done so, he now inclines the well-opened lithotrite towards the stone, slowly closes, and almost certainly seizes it." "But suppose no stone was felt on entering, he is then directed simply to withdraw the male blade an inch or more in the middle line, to incline the blades to the right side about 45°, and then to close them, without altering the axis of the shaft, or otherwise disturbing the central position of the instrument. Thus, in almost all positions, the stone is seized sideways by the blades of the lithotrite, and very rarely by their extremities. If no stone is felt, he then turns them, opened, to the left in a similar manner, and then closes them. Observe, *that the blades are always to be opened before they are turned, for this reason; if the turn is first made and the blades are subsequently opened, the chance is that the male blade, as it is withdrawn, will move the stone away; whereas, if the blades are inclined while open, the stone, if there, is almost certainly seized.* This is one of the many apparently minute but extremely important points of which systematic lithotrity is made up. To return, it is very rare that the stone will elude the search thus far, but if it does, depress the handle of the lithotrite half an inch or so, which raises the blades very slightly from the floor of the bladder, and turn them another 45° to the left, bringing, in fact, the blades horizontally to the left; if successful, turn them gently to horizontal in the right, and close. These five positions—vertical, right and left incline, right and left horizontal, explore the bladder fully, middle, right and left, and will almost certainly find any stone of moderate size in a healthy bladder. The object is, at the same time, strictly to avoid communicating any jerk to the instrument or to the bladder. In all these movements, if properly executed, there has been barely contact of the lithotrite with the vesical walls; at all events, no pressure, nothing to provoke undue pain, or cause contractions of the bladder. If, however, there is an enlarged prostate, causing an eminence at the neck of the bladder, or depression behind it, or the stone is very small, or we are exploring for some fragment, at the close of the case, which is suspected to have eluded previous search, the blade may be reversed so as to point downwards to the floor, and the object sought may then often be secured with ease. If seeking for a small stone or for fragments, we shall employ a lithotrite with short blades, which can, therefore, be reversed with much greater ease than one with long blades.

"In order to do this properly in the normal bladder, the handle of the lithotrite is depressed another inch or so between the patient's thighs, so that the line of the instrument, instead of being directed obliquely a little upwards, is level with, or even points a little below the horizon; the blades, supposed to have been already brought to the horizontal, as before described, are cautiously turned about 45°, say, to the right (right reversed incline), so as to point obliquely to the floor, which should be barely felt or very lightly touched by them. No pressure should be made on this part of the bladder by any part of the instrument, and it is easily avoided by depressing sufficiently the handle of the lithotrite; then close the blades; next turn them back, that is upwards, over to the left (left reverse incline), and close. Lastly, they may be brought round to the reversed vertical position, and the floor lightly swept; this requires the maximum depression of the handle, and is only necessary to pick up small fragments with a short-bladed instrument. But when the prostate is considerably enlarged, and a stone or fragments have to be sought behind it, the lithotrite is reversed without depressing the handle.

"All these movements are to be executed at or beyond the centre of the vesical cavity, the proper area for operating, without hurry, rapid movement, or any other which partakes of the nature of a jerk or concussion, and, if in a fairly healthy bladder, without causing more than a very slight degree of pain to the patient. The operator's eye is also to be so familiar with the scale marked on the sliding rod, that he knows at a glance the exact interval which it indicates as existing between the blades in the bladder. It is essential to good practice, while manipulating the lithotrite, to maintain the axis of the instrument as far as possible always in the same direction. The blades only are to be moved; the shaft should occupy the same inclination, unless when this is intentionally altered. In screwing home the small blade the operator is very apt to move the lithotrite also at each turn of the screw, unless he is conscious of the care necessary to avoid the evil. *All lateral movements, all vibration and concussion, necessarily tell on the neck of the bladder and prostatic urethra,* where the instrument is most closely embraced and its mobility is most limited. To that part of the lithotrite which occupies the anterior portion of the urethra much freedom of lateral movement is permitted, and in the bladder the instrument is free, although in a less degree; but the axis or fixed point, as regards lateral movement, is at the part indicated, which is also the most sensitive spot of the entire passage. Hence the aim of the operator should be to produce in this situation no motion of the lithotrite except that on its own axis. Few of the details of the operation require more practice to master than this.

"There is one important rule with reference to the situation of the calculus in the bladder. The larger it is the more certain it is to be found lying near the neck of the bladder in the ordinary recumbent position, while a small one is usually detected at the back of the trigone. This position of the large stone requires a different method, and it will be found almost invariably successful. The moment the lithotrite enters the bladder it is *not* to be pushed onwards to the bottom of the cavity. First, let the blades be inclined away from the side on which the stone is felt, then push on the female portion of the instrument only, by itself, as far as it will go, maintaining the male blade at the neck of the bladder; it is now only necessary to incline towards the stone, and it will be seized almost certainly at once. But if the operator commences by pushing on the whole instrument, and then withdraws the male blade, according to the ordinary custom, the blade is infallibly drawn against the large stone, which it therefore fails to catch, and presses it back against the neck of the bladder, producing pain, irritation, and perhaps bleeding; this is a practical rule of importance."

Such, then, in the main, is the method of Civiale for finding the stone. It is, doubtless, an admirable one, and, in skilled hands, is at least equal to the English method. For my own part, I have a preference for the English plan, having been originally taught it by Mr. Aston Key, and practised it since with good success. I have, however, followed Civiale's method when the prostate was large, and the stone failed to fall readily into the open blades of the instrument, also in crushing fragments. In fact, the practical surgeon must understand both methods, and employ one or other according to the necessities of the case in hand. Where gentleness is carried out and the bladder is not pressed upon or irritated by the instrument, either method is good; without gentleness and discrimination both are equally injurious. In the English plan, the main point to observe is to maintain the female blade as quiet as possible, and sufficiently depressed to allow of the male blade being drawn forward without affecting the neck of the bladder. With this caution a large stone may be crushed with but little pain or vesical irritation; without it, the first attempt to open the lithotrite will be resisted by the bladder, and the intention of the operator frustrated.

The stone having been seized—its size gauged by the markings on the handle of the instrument—it is to be crushed, and when the irritation caused by the operation is slight, this may be repeated three, four, or more times; under other circumstances, one or two crushings are sufficient. Where the bladder is irritable, the stone of good size, and it is probable that several operations will be required, it is possibly a wise plan to do but little at the first sitting; looking upon it as a tentative step, and, when no bad result follows, the second operation may be more prolonged and effectual.

When the stone is small, one sitting will often suffice to crush it up. I have, however, on several occasions, in healthy subjects with sound bladders, been tempted to crush into fragments at one sitting, stones upwards of an inch in diameter, and have had no reason to regret it. Indeed, on this point no general law can be laid down. What may be wise in one case would be indiscreet in another, and what may safely be undertaken under certain circumstances would be hazardous under others.

In a middle-aged adult, with a healthy bladder and prostate, a large stone may often be rapidly crushed. In an old man with an enlarged prostate, the sittings ought always to be short. When the bladder is irritable, little should be done at one sitting. When the reverse, more may be undertaken with confidence.

On removing the lithotrite, the surgeon should observe that the male blade is screwed well home.

Opinions differ with respect to the removal of the fragments; most surgeons prefer leaving this to the natural action of the bladder, and in this view my own opinions tend, and I have usually practised it, but Sir W. Fergusson advocated instrumental interference. "I have generally," he wrote, "as a first step introduced a lithotrite of considerable size, equal to a No. 10 or 11 bougie, and broken the stone into various fragments. Next I have taken the smaller lithotrite, attacked these fragments, and then have used a small scoop, with the object of removing several fragments, so that the patient might have satisfactory evidence that the stone had been crushed. In a few days after, the small crusher and scoop have again been used, particularly the scoop, wherewith the fragments, when found sufficiently small, have been extracted singly or two or three at a time. Thus, instead of waiting for the spontaneous escape of the broken portions, a process usually both uncertain and tardy, they have been got rid of by direct and precise surgical interference. By this means a stone may be removed with a rapidity little short of the time needful for lithotomy."

"Occasionally, when over-anxious for a rapid cure, I have extracted fragments rather too large to come rapidly along the urethra, particularly in the prostatic or membranous portion, or at the triangular ligament. In some, when the urethra nearest the neck of the bladder has been rather roughly used, there has been considerable irritation." But "in many instances I have been able to effect one or two operations within ten days, which, according to custom, would take weeks or possibly months. In paralysis of the bladder this practice is also proved by Fergusson to be of great value; indeed, he states that "such a condition is positively favorable to that process, for there is generally in such cases an apathetic state of the mucous membrane which permits of the free use of instruments required for the removal of fragments." That the process must be followed with caution, the experience of the able surgeon I have quoted is a sufficient proof. On his high authority I now recommend it.

In the majority of the cases of lithotrity that have fallen into my hands, I have left the discharge of the fragments to natural processes, and had no reason to regret it. In all, success followed the practice. In one only have I subsequently had to perform lithotomy. Where the prostate is enlarged and the fragments prevented from passing, Fergusson's plan of removing them by the scoop or small lithotrite is a good one, and, for the same purpose Clover's ingenious instrument (Fig. 319A) may be used. It is based on the same principle as one employed by Sir P. Crampton, and is a catheter with a large eye to admit fragments, fitted closely into a glass receiver, and an exhausting india-rubber bottle at the end. I have used this on many occasions with satisfactory success. I adopt at times the practice I have been in the habit of using for washing out the bladder, and employ a long piece of tubing fitted on to the end of the catheter, the tubing acting as a syphon and evacuating the contents of the bladder with great facility (Fig. 321). I am disposed to think this method may be practised more extensively with advantage. Since writing this, I find Professor Dittel, of Vienna, has advocated a like practice ('Practitioner,' March, 1871).

The sitting having been brought to a close, the patient should be well covered up in bed, and a tumblerful of warm wine-and-water, or brandy-and-water given, this practice having a tendency to check the rigor that so often follows the operation. The patient should not, if possible, make water for some short time afterwards, and he should then make it in the recumbent posture, care being taken that the chamber into which the water passes is covered with a layer of muslin to catch such fragments of stone as may pass.

After twelve hours of the recumbent position, if no unusual irritability of bladder exists, the patient may get up.

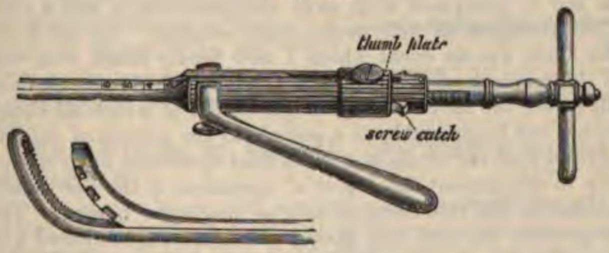
The second operation may be performed within three or four days of the first when no bladder symptoms exist; but where these are present, or have become aggravated, a longer interval should be allowed; a week or ten days being sufficient. The same may be said for all subsequent sittings.

When a fragment becomes impacted in the urethra and produces retention, it should either be gently pushed back into the bladder with a large catheter or removed with urethral forceps. These fragments not only produce retention at times, but epididymitis, from irritation of the caput gallinaginis.

With respect to the use of chloroform in lithotrity, there can be no doubt that it may under some circumstances be given with great advantage, although when the patient has good pluck, there is no reason why it should be administered; but the same care and gentleness should be observed in an unconscious as in a conscious subject, and with it, no more harm to the bladder is likely to accrue.

With respect to the nature of the implements employed in crushing a stone, lightness combined with strength are the two essentials; each part should work very smoothly upon the other, and the means employed to change the action of the instrument from the sliding movement of the blades to the screw should be as simple as possible. Civiale originally employed a three-pronged instrument, but at the present time the screw, as originally invented by Hodgson, improved by Weiss, and adopted by Sir B. Brodie, Key, and others, is the more common form of mechanical power employed. The mode of its application, however, has been greatly improved in recent times, the instruments of Weiss, Charrière, and Matthews supplying us with everything the surgeon could desire. One made by Matthews, of Carey Street, and figured below, is the one I prefer. It is based on the movement employed by Charrière and Weiss, and has a movable handle, which enables the surgeon, when employing the English mode of seizing the stone, to keep the female blade of the instrument perfectly steady. The instrument is worked by the screw, and the change from the screw to the sliding movement is made rapidly by simply moving the thumb-plate—this plate being fixed in the required position by screw catches (Fig. 346).

Fig. 346.



The lithotrite.

The blades of the instrument may be either fenestrated at their ends to facilitate the breaking of the calculus, though such instruments are not now much employed; or flattened and plain, with roughened male blades for powdering or crushing the pieces. These latter instruments, made very small and slight, have been called scoops.

Sir W. Fergusson used the rack-and-pin instrument he invented in 1834, and it is very serviceable. In his hands it answered every purpose, as it would in any other hands had they sufficient practice to render its application easy; for in lithotrity more than in any other operation, it is most important that the surgeon should make himself perfectly familiar with the instrument he employs; none being justified in attempting to crush a stone in the bladder of a living patient until by practice he has learnt to have a perfect command over his instrument and a thorough knowledge of its capabilities; theory being of little value to the lithotritist, and manual dexterity is only obtainable by practice. A complete description of every form of lithotrite employed, as well as a history of the operation, can be found in Sir H. Thompson's admirable work on lithotomy and lithotrity.

LITHOTOMY.

In children, where lithotrity is inapplicable, and in adults, when lithotrity, for reasons already given, ought not or cannot be applied, lithotomy *must* be employed, and lateral lithotomy is doubtless the best, as it is the most useful operation. "In children it is difficult to mention any operation in surgery so uniformly successful as lithotomy is. The incomplete development, and the consequently little susceptibility of the parts involved—the small size of the vessels, and the little risk of hemorrhage—the yielding nature of the textures, rendering force unnecessary in the extraction of the stone—are circumstances that combine to divest the operation of much of the danger that surrounds it when performed in the adult. From childhood to the age of puberty the dangers can hardly be said to increase. Boys of thirteen years of age suffer scarcely more from the operation than children, and for the same reason. Seeing, then, that so little risk and suffering attend lithotomy in children, it is difficult for us to find an equally safe and efficient substitute; it can scarcely, indeed, be said to be required."—*Aston Key.*

In the adult male, lithotomy is rarely resorted to until the surgeon becomes convinced that the removal of the stone by lithotrity is inapplicable, or has failed; at least, such has been the practice at Guy's Hospital for many years, and taking the average of cases of stone in the adult admitted, half only have been subjected to lithotomy. In private practice, the proportion of cases of lithotomy to lithotrity is much smaller, patients applying for advice at an earlier period. From this fact, the worst cases of stone are alone submitted to the cutting operation, and, as a consequence, the mortality is high.

"It is probable," writes Birkett, 'Guy's Rep.,' 1867, "that the rate of mortality after lithotomy must henceforth always appear higher than formerly, in consequence of so many of the patients suffering with stone who might have been cut successfully, being those now selected for the performance of lithotrity. In point of fact, the very cases which swelled the list of successful results no longer appear in the category of those submitted to the cutting operation; but, on the contrary, those patients too ill to recover from lithotrity frequently, as a last resource, submit to lithotomy and perish." At Guy's, lithotrity being the rule in adults and lithotomy the exception, the mortality of the latter operation in adults is one in three, whereas in places where lithotrity is little practised, it is one in five.

Lateral lithotomy, or the operation of Raw, Jaques, and Cheselden is, without doubt, the favorite means of extracting a stone from the bladder among modern surgeons, assuming that lithotrity is inapplicable or inadvisable. As an operation, it has been nobly planned; and to see it performed with skill and precision is still a sight which affords gratification to the youngest as well as the oldest surgeon. In my student days, to see Aston Key cut for stone was an event which I now fondly think over with pleasure and admiration; and the memory of the skill and precision of his acts in this, as in all other operations, is still before me as a standard of perfection at which all should aim.

These remarks are not inapplicable as a preface to the subject of lateral lithotomy; for Key's use and advocacy of the straight staff in that operation have so influenced all his successors that up to the present day "Key's" operation is the one usually performed at Guy's, the exceptions to this rule being so rare as not to be named. The success which has attended this practice has been very good; when, indeed, compared with that furnished from other sources, it seems so remarkable that it is difficult to arrive at any other conclusion than that the mode of operation has something to do with it; for, taking the most reliable statistics—the Norwich 408 cases, in subjects under puberty, and Thompson's 868, eliminating the Guy's cases—the mortality was 1 in every 14½ cases; whilst of Guy's cases and Key's operation during seventeen years, 3 deaths occurred in 171 cases, that is, 1 in 57 cases, the success being four times greater.

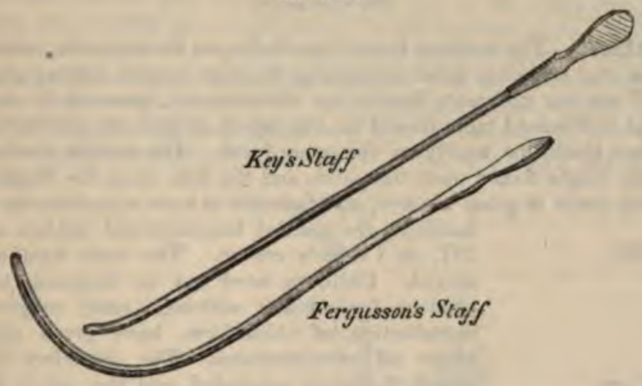
In children under five years of age, these points are still more strongly marked, as out of 400 cases tabulated by Thompson, the mortality was 1 in every 13½; the Norwich not being quite so good; whilst at Guy's, after Key's operation, in my old table, it was 1 in 23½ out of 73 cases, and *more recently, during seventeen years, ending in* 1874, 100 *patients have been cut consecutively without a death.*

This success is certainly more striking than I anticipated when I began the comparison, and must in a measure, if not altogether, be ascribed to the greater safety of Key's operation.

I propose now to describe the operation of lateral lithotomy, and I shall do so after what I believe to be the best method, that of "Key," giving also that with the curved staff. But, first of all, as to the instruments required.

The staff, whether straight, as in Key's operation, curved as in others (Fig. 347), or rectangular, must be regarded as a director. It is a means the surgeon employs to guide his knife into the bladder, and I may say with Key, that "the advantage of a straight over a curved line as a conductor to a cutting instrument is too obvious to require any comment. Is it surprising that the blind should err in a crooked path?" Key's staff is blunt-pointed as a sound, and more deeply grooved than the common staff, to prevent any risk of the knife slipping out; the groove is in the centre of the staff, not at one side as in the ordinary curved one, and it runs to within half an inch of the end. "Its chief superiority," writes Key, "consists in allowing the surgeon to turn the groove in any direction he may wish."

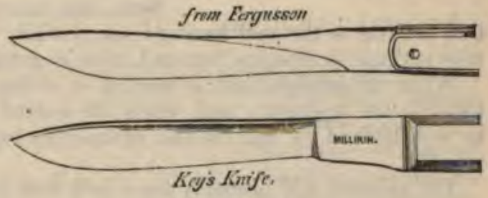
FIG 347.



The staff must vary in length and size according to the age of the patient and size of the urethra, it being well to use as large a one as will pass readily down the urethra.

The **knife** varies much with the fancy of the operator. That employed by Key (Fig. 348) and his successors resembles in form a common scalpel, but is longer in the blade, and slightly convex in the back near the point, to enable it to run with more facility in the groove of the director. Different sizes are required for a child and an adult.

FIG. 348.

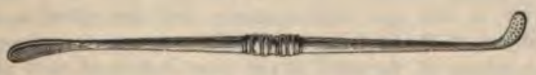


The knife as employed by Sir W. Fergusson (Fig. 348) is given as a type of that required for the curved staff.

A probe-pointed bistoury or blade with a round point is sometimes of use to enlarge the vesical opening when not made free enough, or, to give vent to a large stone.

Lithotomy forceps should be made of several shapes and sizes, and a scoop (Fig. 349) ought also to be at hand. It is used by passing it behind the stone and fixing it there by the pressure of the left index-finger, the instrument with the two hands being withdrawn with the stone.

FIG. 349.

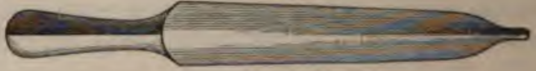


Lithotomy scoop.

When the perineum is very deep, and some extra guide is required by the surgeon for the introduction of his forceps into the bladder and the extraction of the stone, the blunt gorget (Fig. 350) may be used, the instrument, guided by its beak, being passed into the bladder upon the staff, and upon this the forceps can readily be introduced.

The gorget is never needed in children, but in adults it is often of great use.

FIG. 350.

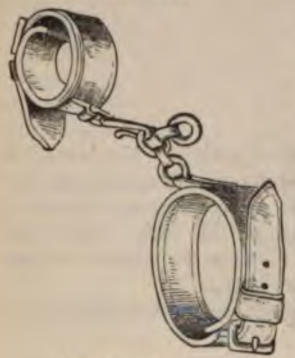


The blunt gorget.

The operation.—The surgeon having decided upon his operation, selected his instruments, and seen that he has at hand everything he may require, having also obtained the help of three if not four assistants besides the chloroformist, proceeds to place his patient.

A narrow but well-raised table should be employed, so that the patient's perineum and the surgeon's face should be nearly on the same level. The patient should be placed on his back with his thighs flexed upon the pelvis and the legs upon the thighs, the hands of the patient being made to grasp his feet, and fastened in such a position by the figure-of-8 bandage, the padded bracelets and anklets, as seen in Fig. 351, or Clover's crutch. The neck ligature is never required. Children need not be fastened, but it is more prudent for adults; although some surgeons, since the introduction of chloroform, have given up the practice under all circumstances. The shoulders should be well raised, the knees separated, and the pelvis kept well down upon the table by two assistants; the surgeon should also see that the patient is quite straight, the line of the umbilicus being the best guide to this position. *The perineum should be perpendicular.* The surgeon may then pass the staff, and having introduced it well into the bladder, and felt *as well as heard* the stone, he is to entrust it to the hands of an assistant, one who can confidently be relied upon to hold it in the position in which the surgeon has placed it, and who will not draw it forwards in any degree. This point is of importance, for there is good reason to believe, that many of the mishaps connected with the operation are due to the staff having been partially withdrawn from the bladder by an assistant, who perhaps in stooping forward, tries to get a sight of the operator's movements.

FIG. 351.



Lithotomy bracelets.

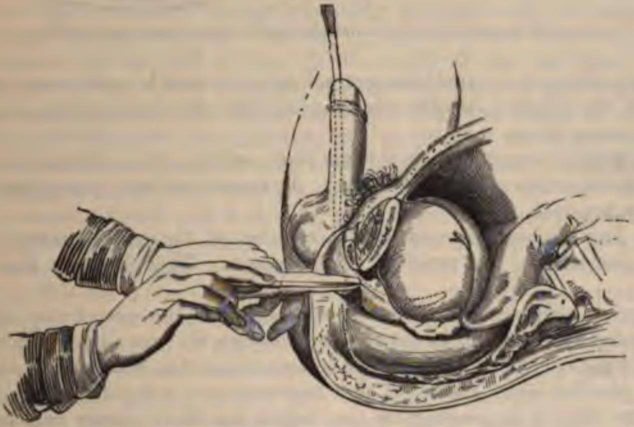
When the straight staff is used, it is to be held well up, with the handle slightly tilted towards the operator; and, when the curved staff is employed, some surgeons like it to be well hooked up against the symphysis, but, under all circumstances, it is to be held steadily.

The surgeon will probably have seen that the perineum has been shaved, and before he operates have examined the prostate per rectum and scanned the perineum. The operator may then proceed with the *first step* of the operation, viz., to lay bare the staff, to expose the groove of the director that is to guide his knife into the bladder; and the point at which this opening is desired is *at the membranous portion behind the bulb and in front of the prostate;* Blizard, Martineau, Stanley, Key, and Fergusson, all laying stress upon this important point. With this view, the perineal incision is to be made, and in lateral lithotomy this is usually situated on the left side, the line of incision lying from the left of the median line of the perineum downwards, backwards, and outwards, midway between the anus and the left tuber ischii. The incision is usually from three to three and a half inches long. Some surgeons commence the cut an inch in front of the anus; others fix it at one and a quarter to one and three-quarters, but this point is not one of primary importance. The object of the incision is to make a free external opening, to enable the surgeon to reach the groove of the staff at the part indicated, and allow subsequently of the removal of the stone, and a point midway between the scrotum and anus is probably the best guide to follow; the length of the perineal region varying greatly in different subjects.

In making this perineal incision, the left thumb of the operator should be firmly fixed above the point at which the knife is to be introduced; and it is well for the surgeon, with he finger of the left hand, to hold the staff firmly at the root of the penis at the same ime. The point of the knife may be well introduced into the soft parts in the line of the irector, and the tissues freely divided in the cut downwards, a second or third touch of he knife being made to complete the section. If these be made too low the rectum is iable to be wounded. In this incision the perineal triangle and ischiorectal space are aid open, and the skin and fascia with the transverse perineal muscle and its artery ivided.

The surgeon having exposed the groove of the director (staff) that is to guide his knife nto the bladder, should then proceed to the *second step* of the operation. For this purpose, when the curved staff is used, he should introduce the forefinger of his left hand into he wound, and feel for the staff *behind and to the left of the bulb*, and having clearly made out the two edges of the groove and along his nail between them, he should introduce he point of his knife upon the nail of the finger into the groove, and having clearly ivided the tissues sufficiently to make him confident that the point of the knife is well nto the groove of the staff, complete his deep section by pushing the knife along the groove of the staff into the bladder, lateralizing it to divide the left lobe of the prostate and neck of the bladder sufficiently (Fig. 352). This step being performed in Key's operation as follows:—"The point of the knife being kept steadily against the groove, the operator with his left hand takes the handle of the director, and lowers it till he brings the handle to the elevation described in Fig. 353, keeping his right hand fixed; then with an easy, simultaneous movement of both hands the groove of the director and the edge of the knife are to be turned obliquely towards the patient's left side; the knife, having the proper bearing, is now ready for the section of the prostate; at this time the operator should look to the exact line the director takes, in order to carry the knife safely and slowly along the groove, which may now be done without any risk of the point slipping out."—*Key*.

Fig. 352.



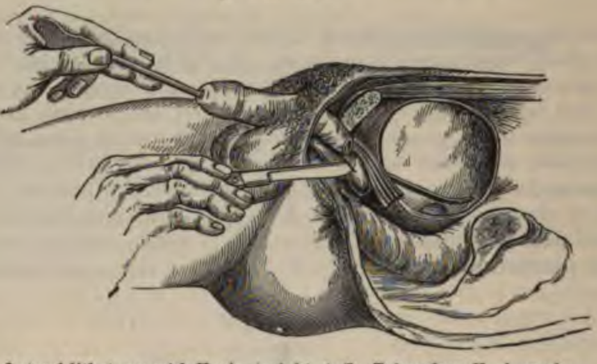
Lateral lithotomy with a curved staff.

"In the majority of cases it will merely be necessary to pass the knife along the director, and having cut the prostate to withdraw it without carrying it out of the groove, varying the angle according to the age of the patient, the width of the pelvis, and size of the stone. As the direction in which the prostate should be divided, in order to adhere to Cheselden's operation, is obliquely downwards and outwards, increasing the angle at which the knife enters the bladder will incur no risk of wounding the pubic artery. The knife may be conducted with deliberate care into the bladder, the resistance afforded by the prostate will be readily felt, and the hand of the operator should be checked as soon as he feels the prostate has given way."—*Key*.

The surgeon knows when he has entered the bladder by the absence of resistance, and occasionally by a rush of urine. He should remember, however, that some urine will escape so soon as the urethra has been opened, and not be misled by the fact. The angle which the knife makes with the staff, regulates the size of the incision into the neck of the bladder. When the knife is in a line with the staff, the incision will be limited; the larger the angle the knife makes with the staff, the larger will be the wound.

As a rule, a large wound can be of no advantage unless the stone is very large. A small wound, however, is a disadvantage when the stone is of medium size; for although the neck of the bladder is capable of a good deal of dilatation under moderate force, any severe laceration of the prostate is almost certain to be followed by bad results. Surgeons differ much upon this point, some recommending dilatation in preference to free incisions into the neck of the bladder, whilst others prefer free division of tissues rather than run the risk of lacerating them.

FIG. 353.



Lateral lithotomy with Key's straight staff. Taken from Key's works.

Moderate dilatation is certainly free from risk; while severe dilatation is dangerous, inasmuch as it necessitates great laceration. As a rule the incision should never exceed the limits of the prostate.

The bladder having been opened, the *third step of the operation* remains to be performed, which consists in the removal of the stone. This is to be done by means of forceps.

The knife having been withdrawn on the completion of the second step, the index-finger of the surgeon's *left* hand should be introduced through the wound into the bladder, guided by the staff; and the operator ought always to remember that *till the finger has been fairly passed into the bladder upon the staff, this instrument is not to be withdrawn;* although when the bladder cannot be reached by the finger, the blunt gorget may be passed along the staff to act as a guide to the forceps. The forceps, held in the surgeon's right hand, is then passed into the wound upon the left index-finger, and, guided by it, pushed into the opening, the forceps being introduced into the bladder at the moment the finger is withdrawn.

"Having delivered his knife to the assistant, the operator takes the staff in his right hand, and passing the forefinger of his left along the director through the opening in the prostate, withdraws the director, and exchanges it for the forceps, passes the latter upon his finger into the cavity of the bladder."

"In extracting the calculus, should the aperture in the prostate prove too small, and a great degree of violence be required to make it pass through the opening, it is advisable always to dilate with the knife rather than expose the patient to the inevitable danger consequent on laceration."—*Key.*

The forceps should be full-sized, and introduced into the bladder closed *flat upon the stone*, and immediately opened, the stone generally being at once caught in the blades, the rush of urine carrying it towards the wound. The stone should be grasped boldly, and when seized, be slowly and deliberately extracted, the extracting force being made in the direction of the axis of the pelvis *downwards* and backwards, and then forwards; a little rotatory and side-to-side motion of the instrument at times facilitates the extraction of a calculus, the surgeon at the same time with his index-finger pushing the soft parts off the stone. Before extracting, the operator by the sensation given to the forceps, will assure himself that the bladder is not caught.

It is in this third step of the operation that the surgeon frequently meets with his difficulties, and much discretion and fertility of resource are often needed to overcome them, since no definite rules can be laid down as a guide. The stone may elude the grasp of his instrument; sometimes it clings to the bladder above the wound behind the symphysis, and is thus without the reach of the instrument; at others, it is caught in the fundus, under which circumstances the pressure of the hand of an assistant above the pubes becomes of value, or the injection of a stream of water is advantageous. Occasionally, although rarely, the stone may be encysted. At times, when the stone is very small, it may be washed out with the first rush of urine, and consequently not felt. I have seen this happen in a child. At times a bladder may be opened and no stone found; "but from all my experience," writes Sir W. Fergusson, "I feel justified in stating my conviction that most of the cases heretofore related as instances where the incisions for lithotomy have been made, and a stone has not been present, have been examples where the surgeon has failed to reach the bladder." In children, this is particularly the case, the surgeon pushing the bladder inwards off the staff. This accident is liable to occur when the neck of the bladder is not sufficiently opened. After the removal of the stone, the finger or sound should be introduced into the bladder to ascertain the existence or non-existence of a second.

Fergusson describes the operation as follows:—

"The breech should now be brought to the margin of the table, when the assistant who has charge of the staff should be desired to hold that instrument in his left hand, nearly perpendicularly with the concavity of the curve touching the upper part of the triangular ligament, and to draw the scrotum slightly upwards and a little to the right side with his right hand, while he stands on the patient's right side. Then the surgeon should seat himself in front of the perineum, having previously arranged with an assistant about having the instruments handed to him, or having already assorted them properly in a chair at his side. Now it may be well to pass the forefinger of the left hand, oiled, into the rectum to ascertain the size of the prostate, and also the depth of this organ from the surface; next, having withdrawn his finger, he should trace the course of the ramus of the pubes and ischium on the left side, ascertain the position of the tuberosity of the latter bone on each side, and having scanned the whole surface, should proceed to use the knife, holding it as he would a scalpel or bistoury as represented in Fig. 352. The point of the blade should be entered about one inch and three-fourths in front of the anus, about a line's breadth left of the raphe, pushed through the skin and carried by a kind of sawing motion down the left side of the perineum, about an inch and a quarter beyond the anus, the middle of the incision being at equal distances from the latter part and the tuberosity; next, the blade should run along the surface of the exposed fat and cellular tissue, and then the point of the forefinger of the left hand should be thrust into the wound a little in front of the anus, so as to penetrate between the accelerator urinæ and the erector penis muscles, the knife being applied to any part which offers resistance, when, with a little force to separate the tissues, the top of the finger can be placed upon the membranous portion of the urethra, and the groove in the staff may be distinctly felt. The point of the blade, with the flat surfaces nearly horizontal (Fig. 352), should now be carried along above the finger, made to perforate the urethra about three lines in front of the prostate, and then be slid along the groove until it has entered the bladder, having slit open the side of the urethra and notched the margin of the prostate in its course. If the stone is supposed to be of considerable magnitude the blade should, in withdrawing it, be carried a little out of the groove so as to increase the incision of the prostate. The forefinger of the left hand should next be slipped slowly into the bladder along the staff, in such a manner as to cause dilatation of the surrounding textures, and its point should be moved about in search of the stone, which, being found, should be retained in a position near the neck of the viscus; then the assistant should be desired to remove the staff, and the surgeon should introduce the forceps along the upper surface of the finger, slowly withdrawing the latter as the former makes progress; their entrance will be denoted by a gush ot urine, at which instant the blades should be separated, when on gently approximating them the stone will, in all probability, be felt inclosed; if it is not, the process may be repeated if the water still flows, but should the bladder now be empty the closed blades should be quietly moved about the bladder until the stone is touched, and at this time, in opening and closing them, great care should be taken to avoid any injury to the bladder. To make sure that the membrane has not been grasped it is well to move the forceps a little before commencing extraction, when, if all is right, the process should be effected by a slow zigzag movement in a direction towards the floor, and with a slight pulling force should this be required, as is most likely if the stone be large. Extraction being effected, the operation is completed."

As soon as the operation has been completed, the patient should be unbound and any bleeding vessels twisted. In children, the introduction into the wound of a piece of ice, or the application to the wound of a cold sponge, with or without ice, is usually enough to arrest any hemorrhage, and, in the adult, the same practice, as a rule, suffices. When, however, the hemorrhage is persistent, a piece of sponge or a sponge tent should be introduced into the wound up to the neck of the bladder; such a proceeding arrests bleeding, though not the flow of the urine, which percolates through the sponge. The sponge may be removed at the end of twenty-four hours. This practice is strongly advocated by my colleague, Mr. Cock.

Liston was in the habit of introducing a gum-elastic tube, six inches long, through the wound into the bladder, to carry off the urine for the first two days, and fastening it in with tapes. This practice is still followed by some. It is, however, quite unnecessary, and at Guy's we use the tube only in exceptional cases—that is, when severe hemorrhage ensues, the wound being plugged around it. Dupuytren employed the same kind of tube, to which was attached a circular piece of oil silk at its centre like an unribbed umbrella; sponge or charpie was introduced between the tube and silk when bleeding took place, after the upper end of the tube had been introduced through the wound into the bladder. Matthews has adapted an india-rubber bag around the tube, which can be introduced into the bladder empty, and then expanded with air and water. It answers the same purpose as Dupuytren's *canule à chemise*, and is, probably, more efficient.

In exceptional cases, when the bulb is cut into, it may be necessary to apply pressure with the finger on the pudic artery to arrest bleeding.

The patient having been placed in a bed, a good draw sheet should be placed beneath his hips and a pillow behind his knees to keep them flexed, while the knees *should not be tied together*. A sedative may be employed to give rest, but beyond this, little or no medical treatment is required. The diet should be nutritious but unstimulating, and wine and meat given as soon as the appetite demands. The bowels, if not acting naturally on the fifth or sixth day, should be cleared by an enema or mild aperient, such as castor oil, and the horizontal position should be maintained till the wound has closed. Key has remarked that in children partial incontinence is apt to follow when this rule has not been observed.

SOURCES OF DIFFICULTY IN LITHOTOMY, AND HOW TO AVOID THEM.

The *difficulties* connected with the operation are too often due to carelessness and too great speed, consequently they are mostly of the surgeon's own making.

If, however, he *feels the stone* and *hears its ring* before operating, he is sure of its presence, and knows also that the staff is in the bladder, and that it has not passed through any false passage in the urethra or between the bladder and rectum. If, moreover, *before* cutting he assures himself by touching the staff that it has not been displaced he has a direct guide down to the calculus.

If *when* cutting, after having exposed the groove of the staff, and then proceeding to the second step of the operation he feels the two borders of the *groove* with the nail of his left index-finger, and with certainty cuts between them *into* the groove, he will be still sure of his guide into the bladder, and not likely to fall into the not uncommon error of mistaking the side of the staff for the groove and thus going astray.

If, again, when running his knife down the director into the bladder, he pushes it sufficiently far as to feel all resistance cease, and for urine to flow, he may be certain that the bladder has been opened. And if, on introducing his finger into the bladder, "he never pushes the point of his forefinger onwards unless he feels certain that he has it between the staff and the wound," he is not likely to make a cavity in the cellular tissue outside the bladder with his finger, or to push the bladder off the end of the staff; and, if he never removes the director or staff till his finger or gorget has been introduced into the bladder as a guide to his forceps, he is still free from error.

In the last step, he has only to handle his forceps boldly, to grasp the stone fully, and, in extracting it, *always to draw downwards and backwards*, and he will complete his operation without a mishap.

The external wound should always be free, the internal limited; moderate dilatation of the neck of the bladder being free from harm.

If in operating, the surgeon lose his guide, from the end of the staff slipping out of the bladder and he be unable to effect its reintroduction, or if by some error he has missed the staff, and allowed his knife to travel by its side, and thus failed to find the bladder, it is better to relinquish the operation, let the wound heal, and operate again, for without the guide of the director, the operation is an impossibility, and all manipulation hazardous. But so long as the staff is in the bladder, errors may be corrected and the operation completed. For by the reintroduction of the knife along the groove, an opening into the neck of the bladder that has been made so small as to forbid the introduction of the finger may be enlarged, even when the neck of the bladder has been pushed backwards and the finger seems about to travel into an unknown region.

Should the *rectum* receive a *small* wound during the operation it may be disregarded, as it is rarely followed by any injurious effect, and even when the wound is large, it is well, perhaps, to leave the case to nature. Should it not heal, the case may have to be dealt with as one of fistula in ano, by division of the sphincter.

At times, the walls of the rectum *after* the operation may slough from the injury they sustained during the removal of the stone; but such cases usually do well when left alone. In my own practice, this sloughing took place after the extraction of a large mulberry calculus, but the case did very well, nor was the recovery tedious.

Prostatic enlargement may be a cause of difficulty in the operation in elderly patients, and when with this enlargement there is rigidity the difficulties are increased, for the surgeon, under these circumstances, in order to make a sufficient opening into the bladder, may have to travel far into the pelvis upon the staff, and when the bladder is opened he may be unable, on account of its depth, to reach it with his finger. Under these circumstances, the blunt gorget becomes of great value, as it can readily be run along the straight or curved staff into the bladder, and form a certain guide to the introduction of the forceps. Martineau was very fond of the blunt gorget in most cases, and I am tempted to think, that in adult subjects it might now be used more frequently with advantage. I have found the greatest benefit from its use in several cases.

When the prostatic enlargement encroaches on the bladder, the vesical lobe may be lacerated by the blades of the forceps and torn away; and prostatic adenoid tumors may likewise be enucleated. Key noticed this in 1837; Fergusson brought the subject forward at the Pathological Society in 1848; Cadge exhibited two specimens in 1862; and in 1878 I reported two others. I removed one in the fork of my forceps, an inch in diameter, on January 19, 1875, when operating for stone upon a man, æt. 67, with a mulberry calculus one inch and a half in diameter, and the man' made an excellent recovery. The second was from a patient, æt. 70, who was operated upon in February, 1876; the prostatic tumor being enucleated during the extraction of a large stone with the forceps, and the recovery was complete.

When the stone is *soft, friable*, and comes away piecemeal, it is wise to wash the bladder well out with a stream of tepid water; and, at times, when the stone is apparently held by the bladder in such a position as forbids its being caught by the forceps, a stream of water through the bladder may dislodge it and allow of its removal.

Very large stones should be crushed through the perineal wound before their removal, and a short strong lithotrite is the best instrument for that purpose.

In moderately large stones, when the wound in the neck of the bladder is not large enough, Liston's advice should be followed, and an incision made on the opposite side of the neck of the bladder by passing a blunt-pointed bistoury into the wound, guided by the finger, and turning its edge towards the *right* tuber ischii. Martineau says that he likewise often enlarged the inner wound two or three times, to facilitate the escape of the stone.

When a *second stone* forms in the badder, and another operation is demanded, there is no reason why it should not be performed in the same position and manner as the first, and with equal success. I have recently at intervals of three and fifteen months had to cut a patient, æt. 60, three times for stone, removing on the first occasion seven calculi, on the second two, and on the third two, with good results. The stones averaged on each occasion more than an inch in diameter. The patient did as well after the second and third operations as after the first, and is now quite well. The Norwich statistics, as compiled by Mr. C. Williams, show that a third operation may be performed with like success. ('Lancet,' May 18, 1878.)

Lateral lithotomy has hitherto been described, and, without doubt, as a general operation is the best; nevertheless, other operations have been suggested and adopted. Among these the so-called *median operation* demands notice. It is the old Italian or Marian method, based upon the precept "a small incision, much dilatation," and has been revived by Allarton. It is performed as follows: The operator first introduces an ordinary grooved staff into the bladder, and gives it to an assistant. He then passes his left forefinger into the rectum, with the palmar surface upwards as far as the *apex of the prostate*, and holds it there, as a guide to the next step of the operation. He then takes a long straight bistoury, and, with its edge upwards, introduces it about half an inch in front of the anus in the median line, down to the membranous portion of the urethra or apex of the prostate, into the groove of the staff, and presses it towards the bladder for about half an inch. He then cuts upwards, dividing the membranous portion of the urethra freely, and the soft parts of the perineum, making an external wound about an inch and a half long. Through this wound he next introduces a long ball-pointed probe along the groove of the staff into the bladder, then withdrawing the staff. Upon this probe the finger is passed into the bladder with a rotatory movement, the prostatic portion of the urethra and neck of the bladder being dilated, the forceps are then inserted into the bladder and the stone removed.

Where the stone is large, Allarton employs Weiss's three-bladed female dilator, or Arnott's hydraulic dilator.

Upon the whole, however, modern experience does not give much support to the operation. It may be done with safety when the stone is small; but when large, there must of necessity be too much laceration of the neck of the bladder and prostate to render the operation equal to the lateral.

In children, the dilating process is dangerous, and apt to be attended by a tearing away of the neck of the bladder from its perineal attachment.

In adult patients where lithotrity is inapplicable and the stone not large, it may be employed, particularly when any loss of blood is to be guarded against; for it is probably the case that there is less loss of blood in adults by this operation than in lateral lithotomy; although in children, there is no difference between the two operations in this respect.

The experience of Guy's surgeons is certainly not favorable to the operation, and that of Norwich in no way tends to give it any support, the mortality of the median being nearly twice as great as the lateral operation; indeed it may be stated, that as an operation, it is losing ground.

Dolbeau's operation must be mentioned as a modification of the median. A full description of it can be found in his work on 'La Lithotritie Périnéale,' 1872. In its first step where the membranous portion of the urethra is opened, it differs in no important respect from Allarton's, but in the second, the neck of the bladder and parts external to it are dilated, while in the third, unless the stone be very small, it is broken before removal.

The dilating process, an essential part of the operation, is effected by means of a very ingenious six-bladed dilator, the blades of which are so arranged as to separate without diverging, by means of two balls which move upon a central stem.

The external parts down to the urethra are dilated first, then the membranous portion of the urethra, and lastly, the neck of the bladder; the passage into the bladder by these successive dilatations being of uniform calibre and with smooth walls. The stone is broken, not crushed, by the "cassepièrre," an instrument that opens in the bladder without divergence of its limbs. The fragments should then be removed with care and the bladder washed out.

Dolbeau claims for this operation great advantages, which are not yet proved. The instruments, however, are very ingenious.

Dupuytren's bilateral section of the prostate for the removal of large stones, with the semilunar transverse perineal incision in front of the anus, meets with few supporters at the present day. He made his first incision with a scalpel down to the membranous portion of the urethra, and afterwards introduced into the groove of the staff a double-bladed curved lithotome which was pushed, closed, down to the stone into the bladder along the staff. The blades were then opened transversely, and the instrument withdrawn. By these means the neck of the bladder and prostate were freely incised, the prostatic section having an oblique direction downwards.

Civiale in 1836, suggested his medio-bilateral operation, "being dissatisfied with the bilateral, and shunning the lateral method on account of the anatomical objections." Having introduced a staff with a median groove, he made an incision in the median line an inch and a half long in front of the anus down to the membranous portion of the urethra. He made also a free opening into the urethra, and then introduced an instrument similar to Dupuytren's lithotome, but straight, along the groove of the staff into the bladder, opening the blades when the bladder had been entered, and dividing the neck of the bladder on its withdrawal The finger was then introduced, staff removed, and forceps inserted, the stone being removed as in other operations. It differs little from Dupuytren's except in the form of perineal incision. Sir H. Thompson, who first described this operation in England, as well as Erichsen, have both successfully removed calculi by this operation.

Dr. Andrew Buchanan's operation with the rectangular staff, bent three inches from the point, and deeply grooved laterally with a posterior opening, is essentially a central operation. He suggested it in 1847. The staff is introduced into the bladder, and, guided by the finger in the rectum, the angle of the staff is made to correspond to the apex of the prostate. The operator, still retaining his finger in the rectum, inserts a long straight bistoury in front of the anus, with the blade horizontal and edge turning to the left down to the groove and angle of the staff, and pushing it towards the bladder to stop at the end of the staff. He then withdraws the knife, and as he does so, makes a curved incision through the soft parts around the left side of the rectum towards the tuber ischii, the wound being about an inch and a half long. Dr. Buchanan describes his operation as being half that of Dupuytren's. When the stone is large, the right side of the prostate is cut, thus approaching it more nearly as a whole.

The recto-vesical operation was at one time a very favorite one. The late Mr. Lloyd, of St. Bartholomew's, was about the last English surgeon who freely practised it, whereas now it has been almost lost sight of. The operation consists in the introduction of the knife into the rectum, with the blade flat upon the palmar surface of the right index-finger, the turning of the edge of the knife upwards, and the perforation of the bowel and urethra at the apex of the prostate down to the groove of the staff; the sphincter and soft parts being freely divided upwards in the mediat line of the perineum for about one inch on the withdrawal of the knife. The left forefinger is next inserted into the wound down to the groove of the staff, and the bistoury again introduced with its edge downwards and pushed into the bladder along the groove, the neck of the bladder and prostate being freely divided when the stone is large. The finger is then passed into the bladder along the staff, the staff removed and forceps passed, the calculus being extracted in the usual way. As an ordinary operation, this is greatly inferior to the lateral. König's statistics, as quoted by Poland, show it to be very unsuccessful. When the stone is very large, it may, however, be entertained.

The high operation, or supra-pubic, is one of the oldest, and was practised by Cheselden and Civiale. It was at one time supposed to be the most direct and least dangerous operation, the only dangerous part involved in it being the peritoneum, which can readily be avoided. For large stones it may be entertained.

The operation consists of three stages:—

The *first* consists in exposing the anterior wall of the bladder by a vertical incision made in the median line above the pubes through the parietes, with the patient on his back, his pelvis raised and bladder moderately distended with a 1 per cent. solution of carbolic acid or thymol of the temperature of the body.

The *second* step is that of opening the bladder, and care should be observed that this opening is made in the median line and *close to the symphysis.* This is best done by transfixing the bladder where it is exposed, and opening it from below upwards, care being also observed that the wound in the abdominal parietes is carefully kept open with retractors.

The *third* step is the removal of the stone by means of forceps.

After the operation, the wound in the bladder should be brought together carefully with sutures, and the external wound closed above, a space being left below for drainage, and the case left to nature. The urine should subsequently be drawn off at short intervals.

The statistics of the operation are not quite satisfactory. Gross gives one death in four cases; Civiale, one in two; Humphry, of Cambridge, and Dulles, one in three. The latter author speaks highly of it ('American Journal of Med. Science,' July, 1875; April, 1878). He believes the operation to be deserving of more attention, and should receive a fairer trial than it has yet had.

All these varieties of operations have been detailed, as exceptional cases of stone may be met with in which one or the other may be better than the lateral, but as a general operation, lateral lithotomy is the best, and of the modes of performing this operation, Key's is the simplest and most successful.

Causes of Death after Lithotomy.

When patients die unrelieved with calculus, they generally do so from kidney disease, and in the majority of fatal cases of lithotomy, the same cause produces a like result.

When kidney disease is *not* present any of the operations described for the removal of the stone, when performed with average skill, is likely to be successful. When kidney disease exists, any operation is likely to prove unsuccessful.

These facts are fully illustated in a paper I read in 1862 (Med. and Chir. Society) on the causes of death after lithotomy.

The longer a stone remains in the bladder the greater are the probabilities of renal disease, and, consequently, the larger the stone the greater the risk.

The duration of the symptoms and the size of the stone are consequently valuable aids in forming a prognosis.

When death takes place from so-called shock, it is probably connected with organic renal disease.

In a small proportion of cases, death takes place from hemorrhage; such a result, however, when uncomplicated, being very exceptional. It does not probably occur once in a hundred cases.

Pelvic cellulitis and peritonitis have usually been regarded as common causes of death. Pelvic cellulitis is very insidious, and often only positively made known when some peritoneal complications make their appearance. Its cause has generally been assigned to a too extensive incision of the neck of the bladder, but the careful investigation of a large number of fatal cases suggests the probability, that although a fatal complication, it is one which for the most part arises without urinary infiltration and as a result of continuity with structures that have become inflamed from injury sustained during the operation, or from the prolonged presence of the stone. It is also commonly associated with renal disease, and it is now well known, that under such circumstances, the inflammation of serous membranes is very common. It is consequently an open question as to how far the renal disease or the operation is the cause of the pelvic cellulitis and peritonitis.

Death from acute cystitis may occur, as it may from the hemorrhagic diathesis, pyæmia, chloroform, or any accident.

Uræmia, as a cause of death, is classed with renal disease.

In children, incontinence of urine is apt to follow the operation, particularly when the horizontal position has not been rigidly enforced during the healing process. It is, however, a rare effect.

Wasting of a testis may likewise take place from some disease or wound of the vas deferens. I have, however, known this to occur but once. Cases of it have, however, been recorded by Teevan and others.

STONE IN THE FEMALE BLADDER.

Calculi are doubtless formed as frequent in the kidney of the female as in that of the male, and pass downwards into the bladder, although from the absence of the prostate as well as the shortness and dilatability of the female urethra, they rarely require surgical treatment.

The records of surgery contain many instances in which large calculi have been passed by natural efforts from the female bladder without any very injurious effect resulting, and Mr. Clogg, of Looe, Cornwall, has recorded a case, in which a stone nearly four inches round was thus passed ('Brit. Med. Jour.,' May 2, 1874). But the experience of every surgeon will supply him with instances in which calculi of moderate dimensions have been readily passed, and I have a specimen of mulberry stone, nearly an inch in diameter, which a young woman thus got rid of.

In neglected cases of vesical calculi in women the stone may, however, excite ulceration of the bladder, or be discharged per vaginam.

The *symptoms* of stone in the bladder of the female are very similar to those in the male, such as irritability of bladder, pain during and after the act of micturition, intermittent flow of urine, and hæmaturia, a bearing-down pain and incontinence of urine being common accompaniments. In the female sex, uterine and vesical symptoms are so closely associated, that surgeons cannot be too much aware of the fact, since cases of stone in the bladder are frequently passed over as examples of uterine disease, when a vaginal examination would reveal the true state of affairs; a calculus can often be felt by the finger through the vesico-vaginal septum, but where doubt exists, the sound will settle the point.

The *treatment* of stone in women is far less complicated than in men, on account of the anatomical formation of the parts, and the majority of calculi can be readily removed either by urethral dilatation and extraction or by lithotrity.

The method by *urethral dilatation* is based on the natural one of expulsion, and is applicable in all cases of small calculi. In children, a stone three-quarters of an inch in diameter, and in adults one inch, with the patient under the influence of chloroform may be fearlessly removed from the bladder by rapid urethral dilatation and extraction. Indeed, I have removed calculi two inches in diameter by this means, without any injurious after-effect, but it is probably wise not to make the attempt, the surgeon possessing in lithotrity an efficient aid or substitute.

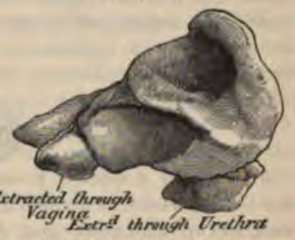
Slow dilatation of the urethra is almost certain to be followed by incontinence, while after rapid proceedings it is rare to meet with this result.

The operation may be performed as follows: With the patient on her back under the influence of chloroform, Weiss's three-pronged dilator should be introduced and rapidly expanded sufficiently far to admit first the left index-finger of the operator, and then the forceps, when the stone, having been seized, can be rapidly removed. I have on several occasions employed the lithotrite for this purpose with the view of crushing the stone should any difficulties be experienced in its extraction, and therefore recommend the practice. On four occasions I have not dilated the urethra at all, but passed the lithotrite or forceps, and extracted at once, and consider this plan is as good as any other, for every surgeon must be struck with the facility with which a finger or any moderate instrument can be introduced into the female bladder when the subject is under the influence of an anæsthetic.

If any difficulty is felt in the extraction of the stone, or it prove larger than can be safely removed as a whole, it may be broken up and removed piecemeal. By these means I took away at one operation without any difficulty or bad result from a child only four years old, a calculus an inch and a half in diameter, and in the year 1869, I successfully removed with facility three calculi from three patients by these means. In female subjects there can be no such hesitation as to the wisdom of removing fragments after the crushing operation as there is in males.

When the stone is too large for removal by rapid dilatation, or the bladder too contracted, inflamed, and ulcerated to allow of lithotrity, the stone should be removed per vaginam, the surgeon in this operation again imitating a method sometimes resorted to by nature. To do this, a clean incision of sufficient length to admit the removal of the calculus has to be made into the bladder through the vaginal septum, guided by a director introduced through the urethra. The wound should subsequently be closed by means of stitches, as in vesico-vaginal fistula.

Fig. 354.



Calculus, half natural size, removed from the female bladder through the vagina.

I have removed, in this way, a stone two inches long, that formed a complete cast of the contracted bladder, with good success. (Fig. 354.) Dr. Aveling and M. Vidal strongly recommend this operation, while Marion Sims thinks so well of it as to assert, "that it is the only justifiable operation for stone in the female bladder," and if by the word operation he means a cutting one, he is certainly right; for where the urethra has been divided to allow of the removal of stone, incontinence is a common consequence.

Urethral lithotomy is here mentioned only to be condemned, as any incision into the neck of the female bladder is liable, as has just been said, to be followed by incontinence of urine, half of the cases, as a rule, being so affected.

By way of summary, therefore, it may be concluded:—

That a stone of moderate size may readily be removed from the female bladder by immediate extraction, and one of larger dimensions by lithotrity and extraction, the patient being *fully* under the influence of an anæsthetic. That where from the size of the stone, immediate extraction is not advisable, or, from the condition of the bladder, lithotrity cannot be performed, vaginal lithotomy is the best operation, while all slow dilatation of the urethra is to be avoided, and all urethral lithotomy condemned on account of the frequency of incontinence of urine as the result of such treatment.

For further information and statistics, *vide* Dr. Aveling, 'Obst. Trans.,' 1864; and paper by author, 'Med.-Chir. Trans.,' 1864.

FOREIGN BODIES IN THE BLADDER.

These are occasionally met with both in the male and female subject. Broken catheters and bougies are probably the most common; but a tobacco pipe, pins, French chalk, slate-pencil, straw, a silver toothpick, penholder, &c., are in the Guy's Museum recorded as foreign bodies that have been removed from the male bladder, and a bone bodkin-case, a cedar-pencil, and a stiletto from the female.

Foreign bodies may, however, obtain access to the bladder through wounds, gunshot or otherwise, or through abscesses connected with bone. Brodie has related a case in which he removed a calculus from a young lady which contained "a small portion of bone, and two imperfectly formed human teeth," doubtless the remains of a blighted ovum; and a second, in which a stone from the female bladder had a hazel-nut as a nucleus.

When a foreign body remains long in the bladder, it acts as an irritant, and usually becomes rapidly covered with phosphates, as has been already stated. In a specimen at the College of Surgeons a foreign body is the nucleus of a uric acid calculus.

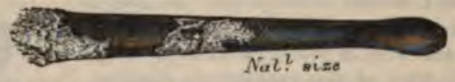
As soon as a foreign body is known to exist it ought to be removed. Where this can be effected through the urethra so much the better; and as long as the substance is in the passage and not impacted, this may be done; but when this cannot be effected and the urethra is the seat of the offending body, a clean incision should be made and the foreign body removed, as incised wounds into the urethra usually heal well, and it is better to make them than to lacerate the urethra by forcible internal manipulation.

I had a case some years ago in which a long hair-pin had been impacted in the penis and perineum with its points forwards, one end being felt at the base of the penis embedded in the tissues beneath the skin. Under chloroform, I pressed the point through the skin and gradually withdrew the pin, which came out nearly straight. A rapid recovery followed, without a bad symptom.

When the foreign body is in the bladder and cannot be crushed by the lithotrite or drawn out by the scoop, lithotomy must be performed, and in adults, when the foreign body is not large, possibly the median operation should be chosen.

The portion of catheter illustrated below (Fig. 355) I removed from the bladder of Mr. B—, æt. 61, on August 23, 1875, by means of a small lithotrite, thirteen days after it had been broken off in the bladder.

FIG. 355.

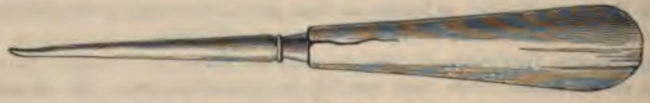


End of catheter removed from male bladder with lithotrite.

I was fortunate enough to catch it at its bulbous end and to withdraw it without much difficulty, a rapid recovery following.

In *women* under the influence of chloroform, the body may usually be readily extracted by means of dressing or other forceps. In the case in which a lady's stiletto (Fig. 356) was in the bladder of a young woman I found the point of the instrument presenting forwards and upwards and fixed in the symphysis. With my left finger in the urethra I pressed it back, and, after some little manipulation with the right index-finger through the rectum, for the patient was a virgin, I so placed the stiletto as to fix the point against the pulp of my left index-finger, and with a pair of forceps introduced upon my finger extracted it. The patient recovered without any inconvenience.

FIG. 356.



Stiletto removed from female bladder.

Most cases may indeed be treated with a pair of forceps in the bladder and a finger in the vagina or rectum to manipulate and place the foreign body in a good position for removal; the surgeon seizing the foreign body by one end. For the removal of such a thing as a hair-pin, a blunt hook may possibly be serviceable.

CHAPTER XXIII.

SURGERY OF THE URETHRA.

A DIMINUTION in the calibre of the urethra, the result of organic changes within its walls, gives rise to ***stricture;*** any encroachment on the passage from without or within causes *obstruction.*

Obstruction occurs when the urethra is narrowed from inflammatory engorgement of its mucous and submucous tissue (the inflammatory stricture of some authors), or from spasm of the urethral muscles (spasmodic stricture); when an abscess or tumor outside the urethra, or any prostatic enlargement encroaches on the urethra, or any fracture of the pelvis presses upon it; and lastly, when a calculus or foreign body is impacted in the passage, or a urethral polypus blocks it up.

Organic stricture is caused by the contraction of inflammatory deposit situated upon, within, or beneath the mucous membrane of the canal, or from the contraction of the cicatrix of a ruptured or injured urethra. The first form may be described as *simple organic stricture.* The second as *traumatic or cicatricial stricture.* The former is the more common, my notes showing 603 examples of the former to 43 of the latter in consecutive cases, or in the proportion of fourteen to one.

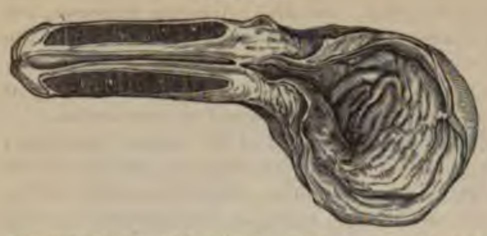
In the majority of cases the contraction of an organic stricture is of a chronic nature, and in some may be readily traced to a more or less distinct chronic inflammation of the passage; but years will frequently pass before the obstruction to the flow of urine becomes of sufficient importance to arrest attention, and a sudden attack of retention of urine, induced by some act of irregularity or exposure to cold, will probably be the first symptom to draw the patient's attention to his condition.

The stricture may consist simply of a perforated membranous diaphragm stretched across the canal, of a narrow band of inflammatory product surrounding the passage, to which the terms "whip-cord," "ring," or "annular" stricture is attached, and in rarer cases to bands of lymph stretching across the passage, and forming what are known as "bridle strictures." It may be general or partial, and when the latter, may have been caused either by some adhesion of the natural rugæ of the urethra, or of some folds of its mucous lining. When the stricture is more extensive, there is hardly a limit to the extent of inflammatory deposit which may exist, from the narrow band already alluded to as forming the "annular" stricture, passing onwards to the broader band which answers to Sir A. Cooper's term of "ribbon" stricture, to the still severer cases in which the urethra is found more or less contracted throughout its entire course. Between these extremes, numberless varieties and degrees of mischief may be observed, the urethra presenting one single contraction, or several independent ones. John Hunter mentioned a case in which six strictures coexisted.

Lastly, the urethra may unquestionably become "impermeable," the pathological specimens in Guy's Museum being sufficient to demonstrate the fact. Such a condition, however, cannot exist uncomplicated with other symptoms, since it is obvious that the urine must have some channel for escape. In these cases, therefore, urinary fistula will always be found. An *obliteration* of the urethra, the result of injury, *i. e.*, traumatic stricture, is also met with.

Locality of Stricture.—For the only definite facts relating to this subject I must refer and I do so with pleasure to the labors of Sir H. Thompson; for although other writers have given their "impressions" upon the subject and published isolated cases, it is to him that the profession is indebted for the analysis of 270 preparations contained in the various museums, by which inquiry alone this question could have been satisfactorily determined. He has most satisfactorily proved what is now generally received as true, that in by far the majority of cases of stricture, the juncture of the spongy and membranous portions of the urethra is its most frequent seat (Fig. 357), and that the inch situated in front of this spot is the next position in point of frequency, while exceptional cases may be found in the prostatic end of the membranous portion, at the external

Fig. 357.



Stricture of the urethra, with dilatation of urethra behind stricture and hypertrophy of bladder.

orifice, or at the terminal two inches of the urethra, but no specimen existed in which a stricture has been observed in the prostatic portion.

Looking over my own cases with a view to inquiring into the *causes of stricture*, I find, omitting congenital narrowing of the urethra, that chronic gonorrhœal inflammation had existed in 273 out of the 646 instances, and that in 78 of these, injections had been employed in its cure; that direct injury was the assigned cause of 43; while in 330 no definite cause could be obtained. With these facts it seems, therefore, right to conclude: "That although gonorrhœa often precedes a stricture, at least half the cases are found in subjects who have not suffered from such a disease; and that when gonorrhœa might be assigned as a cause, the use of injections for its cure does not appear to have had any positively injurious influence in producing a stricture." I may add, that these results can be strictly relied on, as, when noting the cases, considerable care was taken to search out this fact. It may therefore unquestionably be asserted, that injections have not the injurious influence in exciting stricture which some authors have ascribed to them.

Among the 330 cases in which no positive cause could be assigned, were three in which "gout" existed; and several in which the contraction of chancres might fairly be ascribed as the cause of the obstruction.

I have been unable to discover that the so-called phosphatic diathesis has any influence in exciting the formation of an organic stricture, or any other urethral disease, although this is a point upon which Sir B. Brodie has largely dwelt; but there can be no doubt, that any morbid condition of the urine has considerable power in exciting a spasmodic contraction of the muscular walls of the urethra more particularly when an organic stricture exists, and of inducing retention of the urine.

Symptoms.—In a large proportion of the cases of simple organic stricture, an attack of retention of urine is the first thing which attracts the attention of the patient, which may have followed some indiscretion in diet, excess of drinking, or exposure to cold. It is then, perhaps, for the first time, that the patient can bring to his recollection the fact, that other less marked but not less certain symptoms, had existed previously for some time. It may be that a *chronic gleet* had been present for many months, or that some urethral pain or difficulty had attended the act of micturition, that the stream of urine had been somewhat narrowed, divided, twisted, or of a screw shape; or that micturition had been more frequent or prolonged; yet these symptoms by themselves had failed to make sufficient impression upon the mind of the sufferer as to lead him to suspect the existence of a stricture.

It must not be thought, however, that the retention is usually caused by the gradual contraction of the stricture, though in exceptional cases such a condition may exist, yet it is tolerably certain that in the majority, the retention is due to some spasmodic action of the urethral muscles at the seat of stricture, for very slight causes appear capable of exciting spasmodic action of the canal in a diseased urethra, and consequently giving rise to retention; spasmodic and organic stricture being generally combined. Indeed out of 483 cases of stricture consecutively admitted into Guy's, 129, or more than *a fourth*, were suffering from retention. When the stricture is not discovered under these circumstances, it will, if not detected early, soon give rise to other and more characteristic symptoms. The stream of urine will gradually contract so that it will at last cease to exist, the urine passing only in drops. The bladder will become so irritable that the patient will have to rise frequently in the night to micturate, and the effort will be attended with pain; a small quantity of urine, moreover, will probably also be passed; symptoms affecting the rectum will soon appear, and the straining during the act of micturition will be associated with tenesmus; these symptoms at times being so severe as to necessitate, whenever natural relief is sought, the use of the stool instead of the chamber vessel. Prolapsus recti, or piles, also frequently complicate the case; while incontinence of urine may follow.

Under these circumstances, it is clear, that the bladder is never emptied, although some small quantity of urine may be passed at each act of micturition. The retained urine, undergoing partial decomposition, acts as an irritant, and becomes cloudy and ammoniacal, depositing more or less mucus and phosphates. The urine collecting, gives rise to distension of the bladder, which, pressing on the rectum, excites tenesmus and prolapsus, and, interfering with the return of the venous blood, to piles. As the distension increases, the bladder loses its power of contraction, and consequently expands till it overflows—the *overflow* of urine giving rise to *incontinence* which is a direct result of chronic retention. A physical examination of the abdomen of a patient under these circumstances will reveal the distended viscus as a central globular swelling, giving a dull sound on percussion.

During these changes, others no less important are going on at the seat of stricture; the urethra behind the stricture dilates—this dilatation being mechanical and the direct result of the ineffectual efforts of the bladder to overcome the obstruction (Fig. 357). As the pressure continues, inflammation of the urethra and parts around appears, the tissues as they expand become indurated, and after a time, ulcerate from the continued irritation. A few drops of urine then percolate into the cellular tissue behind the stricture, and, setting up suppuration, form a urinary abscess, which to the finger will appear as a deep-seated perineal swelling.

Where the abscess is slow in its formation, it will be indolent and painless, but if rapid, very painful, and when opened or left to natural processes it will almost to a certainty be followed by a *perineal urinary fistula.*

If, however, the abscess and the urethral stricture be left unrelieved, and the bladder with the abdominal muscles still continue to act and ineffectually to overcome the urethral obstruction, the urine, by being forced into the dilated urethra behind the stricture and into the perineal abscess communicating with it, will sooner or later, unless the stricture be relieved, cause rupture of the abscess into the cellular tissue of the parts around, and as a result give rise to extravasation of urine.

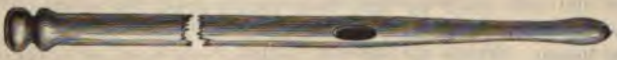
If this giving way of the parts appears during the efforts of the patient to overcome the stricture, or the spasmodic action of the bladder and abdominal muscles, a sudden relief from the previous agony and the sensation that something has given way may for a time lull the apprehensions of the patient, and mislead him into the idea that all is well, but the swelling of the perineum, scrotum, penis, and supra-pubic region, which must soon follow, with the absence of any flow of urine through the natural channel, will reveal to the professional eye the true nature of the accident, and prove that the urethra has given way behind the stricture, and *extravasation* of urine has taken place.

INSTRUMENTS FOR THE DETECTION OF A STRICTURE.

For the detection of a stricture, as well as for its dilatation, *metallic* catheters, *elastic* catheters, or *filiform* bougies may be employed.

The metallic catheter I prefer is that figured 342–3. The curve being short, the end bulbous and a size larger than the shank, this form of catheters is very perfect for mere examination purposes. The elastic instruments are upon the French model, and are made of the same material throughout, a groove in the top answering as a substitute for the ivory head which is never known to keep its place, and when a catheter has to be fastened into the bladder, the benefit of this arrangement is at once proved. These catheters are made very small (Fig. 358), even to the half size. For dilating a stricture they should always be preferred.

Fig. 358.



The filiform bougies are made of the same material as the elastic catheter, or of catgut or whalebone. I prefer the first and last, as they are made very fine and smooth, with or without olive tips; some are of the same thickness throughout, whilst others have finer points than shafts. They can often be insinuated through a narrow stricture when a catheter cannot be introduced, and are consequently of great value for dilating purposes.

As guides into the bladder they are also of equal use, and particularly for internal or external urethrotomy. When these small bougies are used the urethra should be previously filled with oil.

During the development of a stricture, and more particularly when the stricture has become a real cause of obstruction, a patient's general condition is rarely good, and what are generally known as dyspeptic symptoms commonly exist; as a consequence, the patient often loses flesh, looks careworn and ill, the digestive organs failing to do their duty as in health. As the disease progresses, a constant feeling of chilliness is very common, and rigors are not unusual; these symptoms being at times intermittent, and are often regarded as being due to "ague." Whilst a perineal abscess is forming, they are commonly present.

When they are uncomplicated, however, with such a local cause and are still frequent, there is good reason to believe that they indicate some renal complication; for it cannot be too strongly impressed upon the surgeon's mind that no stricture can long exist without producing secondarily important changes in the bladder and kidneys.

Results of Stricture.

When a stricture is neglected, renal disease is certain to follow, and when death takes place as a consequence of stricture, it will be from kidney disease if it has not been suddenly brought about by one of the complications of stricture, such as retention or extravasation of urine. Thus, out of 100 deaths from stricture analyzed by Dr. Goodhart ('Guy's Rep.,' vol. xix, series iii), which took place at Guy's Hospital, in nineteen years the kidneys were suppurating in 41; wasted or inflamed in 18; diseased in a less degree or cystic in 7; and healthy in 34, or about one-third.

Organic strictures are not, however, all of the same character.

The simple stricture is the most usual, and beyond the mechanical effects of its existence has no special feature. **The irritable stricture** is comparatively rare, and is characterized by excessive sensibility on being touched by a catheter, with a disposition to bleed. It is also prone to be associated with chilliness and even rigors. **The contractile stricture** may belong to either of the two former groups; its peculiarity consisting in its tendency to *recontract after its dilatation.* The **cicatricial or traumatic stricture** has characters of its own, and of these, its obstinacy is the most marked.

It is important to bear these divisions of organic stricture constantly in mind, for the successful treatment of a case will often turn upon their recognition.

Treatment.—Before a surgeon can say with certainty that a stricture exists, a urethral examination is a necessity, and this is an operation in which as many difficulties are met with by the inexperienced as in those far more complicated; indeed, without some skill and confidence, the attempt to pass a full-sized catheter down a healthy urethra constantly fails.

To pass a catheter, it is usually wise to place the patient in the recumbent position, with the shoulders slightly raised and the knees separated, the surgeon observing that he is lying quite straight, with the abdomen exposed to the navel, this point being the best guide to the line of the urethra. A large metallic instrument (No. 7 or 8 being the best) should be selected for the examination, and made moderately warm by being dipped in warm water or rubbed by the hand and thoroughly well oiled. The operator should stand on the *left* side of the patient, and raising the penis with his left hand introduce the end of the catheter into its urethral orifice, keeping its point during the introduction of the first three or four inches well to the *lower* surface of the urethra, in order to avoid the lacunæ of the urethra that exist in the roof of the passage. The handle of the instrument at this step of the operation, may be directed over the left thigh of the patient, or, what is preferable, maintained over the median line of the body in the direction of the umbilicus. With the left hand he may then gently draw the penis up the instrument which he with the right allows by its own weight to slip down the passage, simply directing it with a light hand. When its end has reached the bulbous portion of the urethra the handle of the catheter must then be gently depressed in the central line of the body, and if no obstruction exists, the bladder will be entered; the point of the instrument during this movement being kept well along the *upper* surface of the urethra. In a healthy urethra, indeed, the surgeon has little more than to *guide* a metallic instrument into the bladder, the weight of the catheter being alone nearly sufficient to allow it to pass down the passage. Half the errors committed in catheterism arise from a non-appreciation of this fact; the desire to *pass* the catheter originating efforts that interfere with the entry of the instrument into the bladder under proper guidance.

When a stricture exists the catheter will be arrested in its course; and, under these circumstances, it should be withdrawn an inch or so and passed on again, with the handle slightly altered in direction. If the resistance is still felt the instrument should be withdrawn and one of a smaller size employed, and on this failing to glide by the obstruction a yet smaller one, and so on till the stricture is entered.

The seat of stricture or strictures, as well as the nature of the contraction, will be made out by this process. If much pain attend the examination the surgeon has employed either too much force or an irritable stricture exists, and if bleeding follows, this latter probability is strengthened, particularly if no violence has been employed. Catheterism, indeed, ought never to be attended with violence, and if gentle measures do not succeed, no other should be attempted.

In passing a catheter, some prefer the patient to be in the erect position, but I cannot recommend it; there is more chance of inflicting injury in this position by the patient moving, and the surgeon has not so complete a control over his instrument or patient as when he is recumbent. When there is a stricture the erect position is certainly wrong. The mode known as the "tour de maitre" has only to be named to be condemned; though in the hands of a skilled surgeon it may be done with impunity. The plan consists in introducing the catheter with the handle presenting downwards and the convexity of its curve upwards, passing it along the urethra down to the bulb, and then, onwards into the bladder, by describing a half circle towards the umbilicus, the handle of the instrument when it has reached the median line of the body above being gradually depressed, and the end of the instrument in this turn made to enter the bladder.

Treatment of Stricture.

The treatment of stricture must be based on the pathology of the disease; and mild means should always be preferred to forcible or cutting measures.

The pathology of stricture is simple, and consists either in the deposition of inflammatory products in the mucous and submucous tissue with their subsequent contraction; or, in the contraction of a cicatrix, the result of an injury.

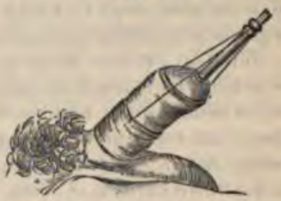
The principle of treatment is also simple, for it is, *primarily*, to dilate the contracted canal, and *secondarily*, to obtain the absorption or breaking-up of the effused inflammatory products. The more simple the means by which these ends can be secured the better.

Where the first end has been obtained without the second, temporary benefit may have been effected, but no more. Where both ends can be gained by simple means, the treatment must be pronounced good. In ordinary cases of organic stricture, there is little doubt that these ends are to be secured by *dilatation* of the stricture; and that by such local treatment alone, the majority of cases of organic stricture may be successfully overcome.

Now, this treatment by dilatation may be *continuous* or *intermittent*. The former method is to be preferred, and should be carried out as follows; it is certainly the most rapid and effectual the surgeon has at his disposal, although it necessitates about a fortnight's rest.

The size of the stricture having been gauged, an elastic conical catheter with a bulbous end is to be taken and well oiled, and as large a one as can be passed through the stricture introduced. Should the English catheter be preferred, it ought to be made soft and flexible by being dipped in warm water or by friction with the finger, and used without the stylet. The penis of the recumbent patient must then be raised by the left hand and drawn forward, as well as slightly downwards, so as to make the urethra as straight as possible. The catheter should then be introduced, and passed gently down the passage. If obstruction be felt, the catheter may be slightly withdrawn and then pressed forwards, the largest instrument the stricture will admit without force being introduced, which having passed the stricture and entered the bladder, it is to be fastened in (Fig. 359), the end of the catheter up to its eye alone resting in the bladder.

Fig. 359.



Mode of fastening catheter in the bladder.

The orifice of the catheter may either be plugged with a peg of wood or the end capped by a piece of india-rubber tubing, the free end being dropped into a urinal, or tied in a knot to prevent escape of urine.

After twenty-four hours if the catheter moves freely in the stricture it may be removed and a larger size introduced, the surgeon being careful not to be tempted to introduce one that fits the stricture too firmly. On the third and following days, the same practice may be followed, and in about ten days a complete dilatation of the stricture will probably have been perfected. If the catheter does not move freely in the stricture, it must be left a few hours longer. When the presence of the instrument in the bladder causes irritation, which is not remedied by such alkalies as the citrate or tartrate of potash with buchu and hyoscyamus, it is wise to have the catheter removed some few hours before a larger size is introduced; thereby giving the bladder rest. When it is impossible for the patient to maintain rest, a catheter may be passed in the evening, retained all night, and removed in the morning. At other times where the symptoms are more severe, some slight intermission of the treatment may be advisable, the passage of the catheter alone being practised. After the stricture has been fully dilated, the daily passage of an instrument for a few days subsequently is all that is required, the interval between the introduction of the catheter being gradually lengthened.

The patient need not always be confined to bed during this treatment; but lie on a sofa or sit quietly in a reclining chair. When movement, however, causes irritation of the bladder, it must be forbidden.

In severe and neglected strictures this plan is one that ought always to be followed when possible, as it is sound in its principle, safe in its practice, and as expeditious as is consistent with the object aimed at.

The *intermittent* form of dilatation is required in less severe cases, or where rest cannot be obtained; and can be carried out by the introduction of an instrument on one day, and after the lapse of one or two more, its re-introduction, followed by the employment of a larger size, and so on, till complete dilatation of the stricture has been effected. It is the second best plan the surgeon has at his command, and although more tedious than the former, in the end successful; patients so treated, however, require doubtless the more frequent introduction of a catheter to maintain the urethra in its dilated condition than others treated by the former plan. For this method of treatment metallic instruments are better than elastic.

When a stricture is so contracted that a catheter cannot be passed even after very careful manipulation, the attempt should be given up and alkalies given. When the urethra is irritable, opium, enforced rest, and the hip bath are of use; and after the lapse of a day or more, success may follow another attempt. When the stricture is reached by the catheter, gentle pressure upon it may be employed; indeed, pressure may be kept up for two or three minutes, the parts often yielding under its influence and allowing the instrument to pass. If this end be obtained, let the surgeon be satisfied and leave the catheter in, whether silver or elastic, for should he remove it, he will in all probability fail to pass a second. If the instrument be silver, an elastic one should be substituted when it is removed.

When a catheter is grasped and "held" in the urethra, the operator may be tolerably sure that he has entered the stricture, and if the end be movable he may be equally sure that he is in a false passage. When the catheter has been held and passed forwards into the bladder, all is well, when it slips suddenly into a movable space, the urethra has probably been perforated. Under these circumstances, when a false passage probably exists, it is wise to give up local treatment for a few days to allow the parts to heal. A stricture should be dilated up to its fullest extent.

It is important to bear in mind, that after the full dilatation of a stricture, contraction will again take place after a time, if the passage be not kept open; but the introduction of a catheter once in every two, three, four, or more months according to circumstances, is generally sufficient to prevent such a result taking place.

What in modern language is called "*the rapid or immediate treatment of stricture*" is in reality its rupture or splitting—it being in all probability a rare thing for a stricture to be suddenly, fully, and rapidly dilated without being lacerated. The plan known by this name has certainly a taking title, and in practice, has apparent advantages which, if supported by experience, would establish its claims on the attention of surgeons. In our day, it is known as that of Holt, but Holt's instruments are mere modifications of M. Perrève's made in 1847, and the same sort of practice has been adopted by Mr. T. Wakley, Dr. Hutton, of Dublin, Maisonneuve, Buchanan, and others.

Holt describes his instrument "as consisting of two grooved blades, fixed in a divided handle, and containing between them a wire welded to their points, and on this wire a tube (which when introduced between the blades corresponds to the natural calibre of the urethra) is quickly passed, and thus ruptures or splits the obstruction."

The stricture having been split, the dilator should be rotated to separate further the sides of the rent, and then withdrawn; a catheter corresponding to the number of the tube being substituted for the purpose of removing the urine. This method, however, no more effects a permanent cure of a stricture than the plan of dilatation already referred since every hospital surgeon has been called upon to treat cases of stricture that had een subjected to the plan and then relapsed. Indeed, there is reason to believe, that fter "*the rapid method*" an early relapse is more common than after others, and that the icatrices of these split structures contract faster than the original. Bad, and even fatal ffects, moreover, are more common *after* the splitting operation than after gradual dilaation.

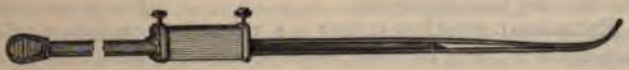
The plan of treatment by dilatation I have laid down is absolutely safe, and never is ollowed by a fatal result; but this cannot be said after the splitting of the stricture, although acts are wanted to establish the proportion of fatal to the successful cases.

To narrow, ring or annular, subpubic or penile strictures, Holt's method is probably well adapted; but for indurated, ribbon, tunnel or complicated strictures, it is dangerous and unsuitable.

When a stricture is associated with the vesical calculus, and it is a matter of necessity to cure the one before lithotomy is employed, the immediate method may be used; but it ought to be understood, that a greater amount of danger attends its practice than follows the more ordinary method.

The best instrument for this plan of treatment is that made by Weiss for Mr. B. W. Richardson, of Dublin. (Fig. 360.)

FIG. 360.



Richardson's dilator.

Yet all strictures cannot be treated by dilatation, for "cases occur occasionally which are so exquisitely sensitive that the passage of a catheter, however skilfully performed, is followed by such severe constitutional and local disturbance as to produce more harm than good, and in which it is clear some other method of cure must be employed, whilst there are others which are relieved by means of the catheter, and even fully dilated, but which have a tendency to re-contract immediately on the omission of the treatment. In the former case the treatment aggravates instead of relieves the symptoms; in the latter it must be continued for life to preserve an open passage. Under such circumstances some other plan of treatment must be adopted;" and I believe now, as when the above words were written, "the most beneficial to be the external division of the stricture from the perineum; and it is to the late Professor Syme that we are here especially indebted for having so ably recalled our attention to the treatment of such troublesome and painful cases" ('Guy's Reports,' 1858).

The surgeon must not, however, in all cases of irritable stricture come to the conclusion, that Syme's operation is required, as it is only in exceptional examples that it is needed. For in some, the irritability rapidly disappears under the use of the catheter, and in others rest, alkalies, and opium have a most beneficial influence. If these fail, the cutting operation may be performed.

Recently the laminaria stalks have been employed for dilating stricture, but for perineal strictures they are dangerous, and are apt to break. For strictures at the orifice of the urethra, from the contraction of cicatrices, they are most valuable, but for all other forms they are ill adapted. A laminaria tent swells to at least twice its diameter, and may be introduced into the urethra dry and left there, a small shield being fixed to one end to prevent its slipping into the passage.

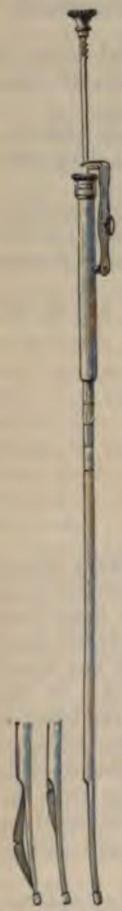
Caustics are not, at the present day, much employed in the treatment of stricture; indeed, few use them. The practice in theory is neither sound, nor in its results certain, indeed it is probably injurious, since it is impossible to apply such a caustic as the potassa fusa to the seat of stricture alone, and, when tissues are destroyed by its influence, they will subsequently cicatrize and contract, and thus add to the mischief. The practice is not one in any way that can be recommended.

URETHROTOMY

is a comprehensive term, and includes the *internal* division of a stricture from the urethra as well as the *external* through the perineum.

Internal urethrotomy has now many advocates, and in hard old strictures it is preferable to their rupture; for strictures also at the orifice of the urethra and within the penis, it is a safe and valuable practice. In the hands of some surgeons it has been much practised advantageously, and Mr. Lund, of Manchester, has lately advocated it. Many instruments have been invented for the purpose, and Stafford's instrument, made in 1827, is well known. Fergusson employed a long grooved director, which he passed through the stricture, and a very narrow-bladed knife, which can be buried in the groove. Many ingenious instruments have been invented, but the best is that which divides the strictures from behind forwards on its withdrawal, such as that represented in Fig. 361. It is one that I have had made on Trélat's principle, perforated at its end for a guide bougie. In strictures of the orifice a bistoury may be used.

Fig. 361.



Urethrotome, perforated at end for guide bougie.

After the division of the stricture, it was a common custom to pass a large catheter into the bladder and leave it in, but M. Gouley has fairly shown that such a practice is not required. In orificial strictures after their division, the laminaria tent is the best to use with a shield.

Maisonneuve employed a filiform gum-elastic bougie as a guide through the stricture, as well as a grooved steel director which is screwed to the bougie and pushed into the bladder. He then divided the stricture by means of a triangular-shaped urethrotome passed along the groove, a large catheter being passed into the bladder when the stricture had been divided.

Subcutaneous perineal urethrotomy is on its trial, but my own experience of it has not been favorable.

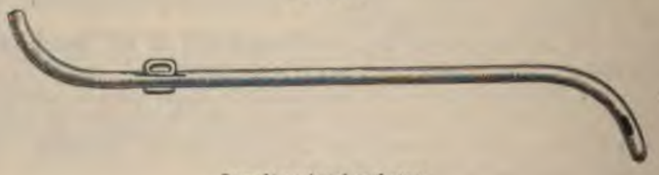
External urethrotomy is a valuable operation in selected cases, and includes three very different measures; *one*, in which the stricture is divided through the perineum upon a grooved director passed through the stricture (*external division* or Syme's operation). The *second*, in which the urethra is opened in front of the stricture and a grooved probe passed through it into the bladder previous to its division (Wheelhouse's operation). And the *third*, in which the perineum is laid open *without* a urethral guide—the stricture being impervious—and to this the term *perineal section* ought to be confined (Cock's operation).

SYME'S OPERATION,

as already stated, is valuable in the highly irritable as well as contractile stricture, in cases which Syme described as strictures that "continue to present symptoms after being dilated," and that "are indomitable by the ordinary means of treatment." It is, moreover, usually successful.

The operation is by no means one of difficulty. A grooved staff as large as can be passed through the stricture is first introduced, the patient having been placed upon his back as if about to be cut for stone. The surgeon should then with perfect precision introduce his knife into the centre of the perineum, and at one stroke, cut down upon the groove situated at the lower border of the staff; and using this as his guide, the perineal portion of the urethra in which the stricture is situated can be readily and freely divided. There are but two important points to be observed in this the second step of the operation; the first is to be certain that the knife touches the groove of the staff, and secondly that the whole of the diseased or strictured portion of the urethra is freely divided. Having succeeded in this, the essential part of the operation, and after a grooved probe or director has been introduced into the bladder through the perineal wound, the sound may be removed, when either a full-sized elastic catheter can be readily introduced through

Fig. 362.



Syme's perineal catheter.

the penis into the bladder and fixed in; or Syme's catheter (Fig. 362) may be introduced through the perineal wound for twenty-four hours.

The patient should then be sent to bed, and a mild opiate given such as ten grains of Dover's powder, if much general or local vesical irritability exists. The catheter may be left in for several days if it fail to cause pain, but if the bladder resents its presence it may be removed; indeed, recent experience has led me to think that the presence of a catheter is scarcely required, although more experience is called for before the omission of its use can be confidently recommended.

After the wound has closed, the occasional introduction of a catheter is essential, and I cordially agree with Professor Syme in thinking "prudence requires that every patient who has had a stricture divided should learn to introduce bougies, since by doing so, at intervals of a week or a fortnight, he will be perfectly secure from future trouble." The division of a stricture no more effects a permanent cure than its dilatation or rupture, and occasional dilatation is essential to maintain its patency.

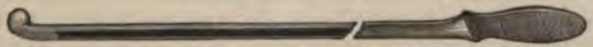
WHEELHOUSE'S OPERATION.

Mr. C. G. Wheelhouse, of Leeds, however, has introduced an operation for impermeable stricture which I believe deserves attention. He states that in his hands and in those of his colleagues it has been most successful.

The instruments required for its performance are as follows :—

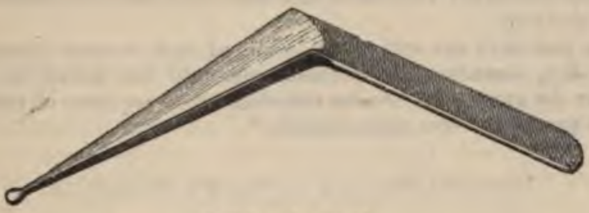
"Lithotomy bandages; a special staff, fully groved through the greater part, but not through the whole, of its extent, the last half inch of the groove being 'stopped,' and terminating in a rounded button-like end (Fig. 363); an ordinary scalpel; two pairs of straight-bladed forceps, nibbed at the points; ordinary artery forceps and ligatures; sponge; a well-grooved and finely probe-pointed director; Teale's probe-gorget (Fig. 364); a straight probe-pointed bistoury; a short silver catheter (No. 10 or 11 gauge), with elastic tube attached.

FIG. 363.



Grooved staff, with button-like end.

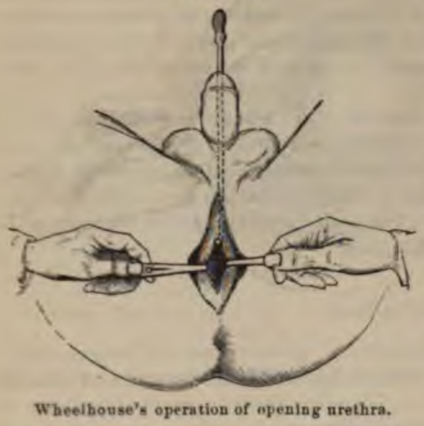
FIG. 364.



Teale's probe-gorget.

The patient is placed in lithotomy position, with the pelvis a little elevated, so as to permit the light to fall well upon it, and into the wound to be made. The staff is to be introduced with the groove looking towards the surface, and brought gently into contact with the stricture. It should not be pressed much against the stricture, for fear of tearing the tissues of the urethra, and causing it to leave the canal, which would mar the whole after-proceedings, which depend upon the urethra being opened *a quarter of an inch in front of the stricture.* Whilst an assistant holds the staff in this position, an incision is made into the perineum, extending from opposite the point of reflection of the superficial perineal fascia to the anterior edge of the sphincter ani. The tissues of the perineum are to be steadily divided until the urethra is reached. This is now to be opened *in the groove* of the staff, *not upon its point*, so as certainly to secure a quarter of an inch of healthy tube immediately in front of the stricture. As soon as the urethra is opened, and the groove in the staff fully exposed, the edges of the healthy urethra are to be seized on each side by the straight-bladed nibbed forceps, and held apart. The staff is then to be gently withdrawn, until the button-point appears in the wound. It is then to be turned round, so that the groove may look to the pubes, and the button may be hooked into the upper angle of the opened urethra, which is then held stretched open at three points thus (Fig. 365), and the operator looks into it immediately in front of the stricture. Whilst thus held open, the probe-pointed director is inserted into the urethra; and the operator, if he cannot see the opening of the stricture, which is often possible, generally succeeds in very quickly finding it, and passes the point onwards *through* the stricture towards the bladder. The stricture is sometimes hidden amongst a crop of granulations or warty growths, in the midst of which the probe-point easily finds the true passage. This director having been passed on into the bladder (its entrance into which is clearly demonstrated by the freedom of its movements), its groove is turned *downwards*, the whole length of the stricture is carefully and deliberately divided on its *under* surface, and the passage is thus cleared. The director is still held in the same position, and the straight probe-pointed bistoury is run along the groove, to insure complete division of all bands or other obstructions. These being thoroughly cleared, the old difficulty of directing the point of a catheter through the divided stricture and onwards into the bladder is to be overcome. To effect this, the point of the probe-gorget is introduced into the groove in the director, and, guided by it, is passed onwards into the bladder, dilating the divided stricture, and forming a metallic floor, along which the point of the catheter cannot fail to pass securely into the bladder. The entry of the gorget into the latter viscus is signalized by an immediate gush of urine along it.

FIG. 365.



Wheelhouse's operation of opening urethra.

The short catheter is now passed from the meatus down into the wound; is made to pass once or twice through the divided urethra, where it can be seen in the wound, to render certain the fact that no obstructing bands have been left undivided; and is then, guided by the probe-dilator, passed easily and certainly along the posterior part of the urethra into the bladder.

The gorget is now withdrawn; the catheter fastened in the urethra, and allowed to remain for three or four days; the elastic tube conveying the urine away to a vessel under or by the side of the bed.

After three or four days the catheter is removed, and is then passed daily, or every second or third day, according to circumstances, until the wound in the perineum is healed; and, after the parts have become consolidated, it requires, of course, to be passed still from time to time to prevent recontraction."

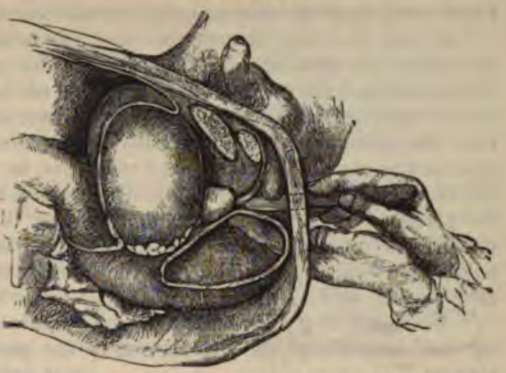
PERINEAL SECTION OR COCK'S OPERATION

is a more difficult and dangerous operation than Syme's, and is called for, moreover, in the more severe cases when the urethra is impervious and no guide to the urethra exists beyond that which the surgeon's knowledge of the anatomy of the parts affords. It should also be remembered that, as a rule, the normal anatomy has been nearly destroyed, for impervious strictures requiring urethrotomy are usually chronic, as well as complicated with extravasation, suppuration, or urinary fistulæ.

The operation I shall describe is that one suggested by Mr. Cock, and known by his name; "the objects aimed at in the operation can be accomplished, while I doubt if those of any other have ever been fulfilled. However complicated may be the derangement of the perineum, and however extensive the obstruction of the urethra, one portion of the canal behind the stricture is always healthy and often dilated, and is accessible to the knife of the surgeon. I mean that portion of the urethra which emerges from the apex of the prostate, a part which is never the subject of stricture, and whose exact anatomical position may be brought under the recognition of the finger of the operator. Thus, when we cannot introduce a catheter by the ordinary method, and even when we cannot tap the bladder through the rectum, it still remains to us *to tap the urethra as it emerges from the prostate*, and thus to effect the desired communication."

The operation which Mr. Cock has described as "tapping the urethra at the apex of the prostate, unassisted by a guide staff," is performed in the following manner, and illustrated in Fig. 366. I have seen Mr. Cock frequently perform it, have done it myself on many occasions, and have no hesitation in strongly recommending it as *the* operation for external urethrotomy without a staff. I give it in Cock's words, taken from 'Guy's Hospital Reports,' 1866:—"The only instruments required are a *broad* double-edged knife with a very sharp point, a large silver probe-pointed director with a handle, and a canula or female catheter, modified so that it can be retained in the bladder (Syme's perineal catheter is the best).

Fig. 366.



Mr. Cock's operation of tapping the urethra at the apex of the prostate.

"The patient is to be placed in the usual position for lithotomy; and it is of the utmost importance that the body and pelvis should be straight, so that the median line may be accurately preserved. The left forefinger of the operator is then introduced into the rectum, the bearings of the prostate are carefully examined and ascertained, and the tip of the finger is lodged on the apex of the gland; the knife is then plunged steadily but boldly into the median line of the perineum, and carried on in a direction towards the tip of the left forefinger, which lies in the rectum. (Fig. 366.) At the same time, by an upward and downward movement, the vertical incision may be carried in the median line to any extent that is considered desirable. The lower extremity of the wound should come to within half an inch of the anus.

"The knife should never be withdrawn in its progress towards the apex of the prostate; but its onward course must be steadily maintained until its point can be felt in close proximity to the tip of the left forefinger. When the operator has fully assured himself as to the relative position of his finger, the apex of the prostate and the point of his knife, the latter is to be advanced with a motion somewhat obliquely either to the right or the left, and it can hardly fail to pierce the urethra. If, in this step of the operation, the anterior extremity of the prostate should be somewhat incised, it is a matter of no consequence.

"In this operation it is of the utmost importance that the knife be not removed from the wound, and that no deviation be made from its original direction until the object is accomplished. If the knife be prematurely removed, it will probably, when reinserted, make a fresh incision and complicate the desired result. It will be seen that the wound, when complicated, represents a triangle; the base being the external vertical incision through the perineum, while the apex, and consequently the point of the knife, impinges on the apex of the prostate. The shape of the wound facilitates the next step of the operation.

"The knife is now withdrawn, but the left forefinger is still retained in the rectum. The probe-pointed director is carried through the wound, and guided by the left forefinger, enters the urethra, and is passed into the bladder. The finger is now withdrawn from the rectum, the left hand grasps the director, and along the groove of this instrument the canula is slid until it enters the bladder.

"The operation is now complete, and it only remains to secure the canula in its place with four pieces of tape, which are fastened to a girth around the loins.

"A direct communication with the bladder has now been obtained, and the relief to the patient will be immediate; unless the kidneys have become irremediably disorganized, we may confidently anticipate a favorable result; and the restoration of the urinary organs will be more or less complete, in proportion as the obstructed portion of the urethra is more or less amenable to the ordinary judicious treatment of stricture.

"The canula may generally be retained in the bladder for a few days, and if the state of the urine renders ablution necessary the viscus may be frequently washed out. The canula may then be removed, cleansed, and reintroduced. A flexible catheter is sometimes more desirable and congenial to the feelings of the patient than a metallic canula.

"If the previous destruction has not been very great, and if the case progresses favorably, the swelling of the perineum and scrotum gradually subsides, the induration disappears, and the urinary sinuses become obliterated. The urethra may then be examined in the ordinary way, to test its permeability, and one may be agreeably surprised to find that the sound or catheter readily passes through the former stricture until it strikes against the canula. An attempt may then be made to introduce a flexible catheter into the bladder, and its passage may, if necessary, be facilitated by passing a director through the perineum into the bladder, and guiding the catheter along its groove. The urethra once restored to its normal condition and calibre, the artificial opening through the perineum soon heals up, and, barring the liability of stricture to return if not attended to, the cure may be said to be complete.

"We must not, however, always expect so favorable a result. I have operated in several cases where the obstruction of the canal was complete, and impermeability permanent."

"In such cases the patient is condemned to pass his water through the artificial opening in the perineum, unless a new passage should be bored to unite the upper and lower portions of the patient's urethra—an operation which I have seldom or never known to be successful."

"The necessity of micturating through the perineum may seem to be a considerable hardship, but with a little arrangement the inconvenience is not very great; and be it remembered that the man's micturition is merely assimilated to that of the other sex.

"To keep the artificial passage in a permeable state it is generally necessary to pass a flexible bougie through the opening occasionally, and to retain it *in sitû* for a few hours. The patient very soon learns to do this for himself.

"I have now under my frequent observation two men, on one of whom I operated twenty-five years ago, on the other twenty; and both are thankful for their condition.

"I have not found this operation, with its result, in a permanent factitious urethra, at all interferes with the sexual function, although it is, of course, a complete bar to procreation."

I have described fully this admirable operation in the words of its originator, and believe it to be the only form of perineal section that ought to be performed in an impervious urethra. It is not sufficiently known. In exceptional cases the surgeon may examine the urethra itself with the view to find a passage through it; and for this purpose use, as a guide to its distal end, a grooved staff introduced through the penis down to the obstruction; the two sides of the urethra being held well apart by forceps, or as suggested by Avery a loop of silk introduced through each edge of the divided urethra. If the surgeon be fortunate enough to slip a fine grooved director through, the stricture will be readily divided. Under these circumstances a catheter should be passed through the penis into the bladder, and the one which had been introduced through the perineun withdrawn. I need hardly say, however, that it is very rare for the surgeon to be able to trace the urethral passage through the stricture.

Complications of Stricture.

I have thus far dwelt upon *permeable* and *impermeable* organic stricture and its treatment, but have made only passing reference to its complications. I propose now to consider these points more fully, including *perineal abscess*, *extravasation of urine*, and *perineal fistula*, all of which are the direct results of stricture, and of local or diffused urinary extravasation.

Extravasation of urine is a complication which will almost necessarily follow a neglected stricture, and the pathological process by which it is produced has been already described. It is one of the means which nature adopts to find an outlet for urine when the natural passage has become so contracted as to forbid its flow, and a complication of great danger. It requires in its treatment, moreover, great decision on the part of the surgeon; the effect of retained urine upon any tissue of the body, except those naturally adapted for its contact, being generally followed by sloughing. The early detection, therefore, of the beginning of an extravasation is important, and requires a few practical remarks.

If a patient, the subject of a stricture, appears before a surgeon suffering from more or less severe febrile symptoms, a parched skin, dry tongue, and a rapid irritable pulse, with or without an occasional rigor, attention should always be directed to the question of extrasation and a careful examination made of the perineum and the parts around, whether there exist any local symptoms sufficient to have attracted the notice of the patient or not, then a circumscribed and almost solid mass will probably be discovered in the region of the bulb, which on firm pressure will be painful. The patient will frequently state that this existed for some weeks and cannot be the cause of all his symptoms. The surgeon, however, must not be misled, since this circumscribed mass is in effect a urinary abscess, the result of a local and limited extravasation, and the symptoms will only disappear when its contents have been evacuated.

What treatment, then, should be pursued? If the urethra be examined, the stricture will almost to a certainty be found much contracted, and the stream of urine very small. Some discharge from the urethra may perhaps be observed, a little of the pus contained within the abscess behind the stricture making its way by the natural passage. If an instrument be made to pass the stricture, it may then only enter the dilated, ulcerated, and suppurating cavity of the abscess situated behind, and it will be a matter of difficulty to find the vesical end of the urethra, and, as a consequence, the instrument will be passed onwards into the bladder in only exceptional cases.

The abscess, however, must be opened and its contents evacuated; for if not, it will to a certainty increase, and being bound down by the perineal fascia, pass backwards and spread mischief around the neck of the bladder, and, in the cellular tissue of the pelvis, to the serious injury of the sufferer.

Yet, at the same time the treatment of the stricture is to be remembered, as no treatment can be regarded as scientific if it be not directed to remedy the stricture, which is the cause of the abscess.

I am well aware some are satisfied to open the abscess in the perineum, and leave the stricture to be subsequently treated by dilatation or other means; yet such a measure is but temporizing, and the soundest and most correct practice is to open the abscess, and at the same time to divide the stricture. This is readily done by passing a grooved staff through the urethra into the abscess, if not into the bladder, and freely dividing all the tissues by a scalpel introduced through the perineum. If the orifice of the vesical end of the urethra can be detected with a probe, a large catheter should be passed and left in, but this point is not of essential importance, as by the operation the surgeon is certain that the stricture has been divided, all pus freely evacuated, the possibility of further extravasation taking place prevented, and a free outlet for the urine at the same time been obtained.

By adopting this practice much time is saved, the stricture being treated and probably cured by the same means that are absolutely essential for the treatment of the complication.

When, however, perineal abscesses occur unconnected with stricture, they should be opened early to prevent their breaking into the urethra and degenerating into urinary fistula. Syme's operation under these circumstances is not required.

The complication of extravasation of urine, however, does not always appear in the form we have been just describing as a local and confined extravasation of a urinary abscess, since it not rarely shows itself as an extravasation of a severer nature; as one more sudden and marked in its symptoms and more fatal in its effects, requiring also at the hands of the surgeon active and energetic treatment. It occurs as the result of a sudden rupture of the urethra, or of the walls of an abscess communicating with it, the rupture taking place suddenly during some effort of a patient, the subject of a narrow and contracted stricture to relieve his distended and overcharged bladder.

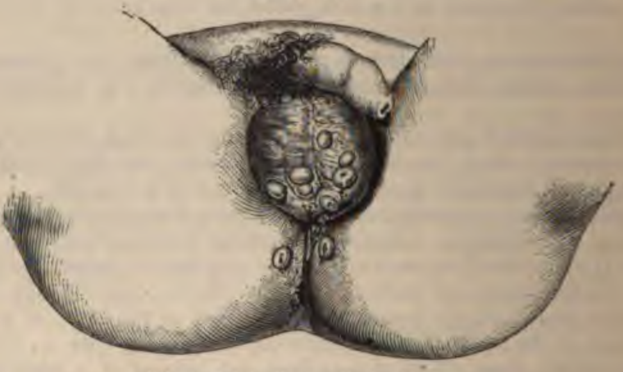
The symptoms by which the complication is manifested are very marked. The patient will probably relate that during some sudden expulsive effort to pass his urine, he felt something give way, and that this sensation was attended with relief to the symptoms caused by the retention of urine. He will soon discover, however, that the relief which he experienced was not the result of a flow of urine from the natural passage; and, from the rapid enlargement of the perineum, scrotum, and penis, will be convinced that something wrong has taken place. This swelling will be attended by a burning pain in the parts thus gradually enlarging, and increased at each effort made to relieve the distended bladder—the absence of pain on the first onset of the extravasation may delude the patient into a false idea of relief and safety. The surgeon, if now called to see the patient, will find him laboring under retention of urine, with the perineum, penis, and scrotum more or less swollen and œdematous from urinary infiltration; the extravasated fluid, perhaps, having made or making its way upwards over the abdominal parietes even to the thorax. If the symptoms have existed long, a peculiar inflammation and gangrene of the integuments will make its appearance, and all the constitutional symptoms described as typhoid will certainly be present.

Under these circumstances the surgeon, in his treatment, has three objects to keep in mind; *first*, to free the tissues, already infiltrated, of their extravasated urine, and thus prevent their total destruction; the *second*, to secure a free and ready outlet for the urine from the bladder, and thus relieve the retention and prevent an extension of mischief; and the *third*, which is no less important, to cure the stricture, and thereby remove the cause on which the complication originally depended.

The first object is readily secured by free incisions made through the integument into the infiltrated cellular tissue, the second may perhaps be fortunately secured by the passage of a catheter, which when it fails, the object may be obtained by puncturing the bladder through the rectum; but this latter practice is only a partial remedy, and not scientific; it relieves immediate symptoms, but nothing more, leaving the stricture, the "fons et origo mali," unnoticed and untreated. The right treatment, therefore, is the one which will relieve the retention, give free vent to the infiltrated urine and treat the stricture, that is, which can of itself fulfil the three required conditions to which attention has been drawn; and this is found in either the external division of the stricture, or in the perineal section. By either operation, the obstruction to the flow of urine is removed and the stricture divided, an outlet is obtained for the urine which has been infiltrated, and a free vent given for subsequent micturition. Free incisions, therefore, ought to be made into the parts infiltrated with urine, as well as the perineal incision extensive and deep enough to lay bare and open freely the urethra, doing this, if possible, upon a grooved staff, forced through the stricture, and when this end cannot be attained, by the operation which has been already described in another page. A small grooved staff may, however, be passed in by far the majority of cases, the employment of some force being perfectly justifiable to make it pass through the strictural portion.

Urinary fistulæ.—These may be the result of a urinary abscess bursting in the perineum or scrotum, or the consequence of a more diffused urinary extravasation, the fistulæ, under these latter circumstances, appearing in the perineum, scrotum, groin, thighs, pubes, or nates (Fig. 367). They are generally the direct consequence of some urethral obstruction. Occasionally, however, they follow an accidental wound in the perineum or urethra, or some such operation as lithotomy.

FIG. 367.



Urinary fistulæ the result of stricture.

When the fistulæ are simple tracts communicating with a urethra behind a stricture, and the tissues through which they pass are healthy, they need not be regarded with any anxiety, as, in all possibility, they will rapidly heal so soon as the urine flows readily the natural way after the dilatation of the stricture.

When, however, the fistulæ pass through indurated and diseased tissues and are associated with a contracted if not impermeable urethra, or are the result of some urinary extravasation and sloughing of the parts, the same success is not always secured. It is true that in a large number of cases when the stricture is dilated and cured the fistulæ will close, but in exceptional cases they refuse to heal, and require the local stimulation of some such escharotic as the nitrate of silver, liquor ammoniæ, tincture of cantharides, the galvanic or actual cautery, to stimulate the indolent passage and assist its contraction. It should be remembered, also, that in all these cases it is the entrance of the urine into the istulæ which prevents their contraction and closure, and that any means by which such n occurrence can be prevented will be followed by recovery. To allow the patient to pass is urine is most injurious. To pass a plugged catheter into the urethra and leave it in will not suffice, as daily experience proves that urine soon flows by the side of the catheter and enters the fistula, the introduction of a vulcanite inelastic catheter into the bladder with its ends open, is, however, a good practice, the urine flowing away as secreted. The est plan is, to have a catheter passed whenever the bladder requires to be emptied, and where the surgeon has dilated the stricture to its full size, as well as instructed the patient to pass an elastic catheter into the bladder, there are very few instances of urinary fistula that require further treatment.

When difficulty is experienced in dilating the stricture, Syme's operation may be performed, the surgeon when he can, laying open the fistula at the same time.

The urinary fistula following lithotomy is best dealt with by the galvanic cautery and catheterism. In these cases, however, the surgeon should always investigate the case sufficiently to assure himself of the absence of a second stone, or of a foreign body within the wound, for I have known in one case a sponge, that had been applied to arrest bleeding, left in the wound and prevent repair. In another a second calculus was overlooked, and prevented recovery, the fistula healed when the stone had been expelled by natural efforts through the fistulous perineal opening. I have likewise seen two cases where some calculous formations took place in the wound and thus kept it open.

Urinary fistula the result of some abscess communicating with the rectum will generally heal as soon as the urine is prevented from entering the passage. The use of the catheter will sometimes effect this; at others, position will suffice, Sir H. Thompson gives a case in which recovery followed the practice of micturating in the prone position for a month. But any means that for a time prevents the passage of urine into the fistula will probably suffice to allow of its contraction. When this does not succeed, the passage may be stimulated by the galvanic or other cautery, and, in exceptional cases, a plastic operation may be called for.

The urinary fistulæ associated with loss of tissue, whether in the penis, scrotum, or perineum, require the greatest amount of ingenuity in the surgeon, as, besides the constriction of the normal channel some plastic operation is often necessary.

ON CICATRICIAL OR TRAUMATIC STRICTURE.

The difference in the cause, the difficulties in the treatment, and the permanency in the nature of a so-called traumatic stricture, have led me to separate the cases thus denominated from that larger class which we have been just considering, the result of local inflammations, and from my notes of forty-three consecutive examples of this kind, in all of which a distinct history could be obtained of some definite accident affecting the perineum, the blow or fall was immediately followed by hemorrhage from the urethra, with or without other symptoms, and, at a later date, by difficulty in micturition.

As a rule, these accidents take place in boyhood or in young adult life, though no age is free from the dangers of such an injury, and the kick of a man or horse on the perineum, a fall upon a pointed instrument, or across a bar, beam, or rail; an injury from a saddle when riding, a blow from a rope, and sloughing of the perineum after a violent contusion, are the principal causes to which the stricture has been assigned in the cases before me. In one and all there was clear evidence at the time of the injury that the urethra was more or less involved, as hæmaturia in almost every case immediately followed, while difficulty in micturition appeared subsequently at variable intervals. In some few cases, several years had passed away before the attention of the patient was called to the smallness of his stream of urine, when some sudden attack of retention was the first symptom which attracted notice; but in the majority of cases, the difficulty of micturition appeared rapidly after the receipt of the primary injury, and went on slowly but surely to increase.

The pathology of these cases is not difficult to understand. The urethra, by the injury, is either partially or wholly ruptured, the wound being transverse; union takes place, and subsequently contraction of the cicatricial tissue, with a narrowing of the urethra and the formation of a traumatic stricture follow. It is this pathological fact which enables us to explain the obstinacy of the symptoms and the difficulty in the treatment.

Complications.—Traumatic stricture is as liable as any other organic stricture to be followed by like complications, since these complications are the result of the obstruction to the urethra, and it is of little consequence in what way that obstruction may primarily have been caused. Among my forty-three examples of traumatic stricture, result; the longer the obstruction exists, the greater the probability, if not certainty, of the production of renal affection.

In 26 fatal cases, the notes of which are before me, the average duration of the stricture was seventeen years; in 5, symptoms had existed under ten years, and in 10, for upwards of twenty years.

When stricture, therefore, has existed for a long period, and more particularly when it has been neglected, it may be inferred with certainty that some disease of the kidneys has been produced, and that the slightest injury or accession of mischief is likely to terminate in death; for I imagine that every subject of renal disease stands, as it were, continually on the edge of a precipice, and that the slightest adverse wind may send him down. The death of so many cases after operations, whether upon the urinary organs or other parts, may be thus explained. No patient with renal disease is able to resist the slightest tax upon his powers, for his vital energy sinks irrecoverably upon the receipt of the most trifling injury.

By way of summary of the treatment of stricture, the following conclusions may be drawn:—

1. At least ninety-five out of every hundred cases of stricture are readily and safely dilated by means of catheters, and every stricture might be so treated if recognized before any complications appeared.

2. Of *permeable strictures*, it is only in the obstinately irritable and contractile forms that any other treatment is called for; and in these, external division, by the plan recommended by Syme, is probably the best operation; though *rapid dilatation, splitting*, or internal division of the stricture may be justifiable under exceptional conditions.

3. Strictures complicated with *urinary abscess* or *extravasation*, in which perineal incisions are called for, should be treated by external division or by Syme's operation, when a staff can be passed through the stricture; by perineal section, Wheelhouse's or Cock's operation, when no such guide can be employed.

4. In strictures complicated with *urinary fistulæ*, the stricture itself should be treated, its full dilatation being usually followed by the contraction of the fistulæ. When this result does not take place, it is essential that all urine be prevented passing into the fistulæ, and the best means to insure this is, by the passage of the catheter whenever relief is required.

5. The *external division* of the stricture is an excellent operation in obstinate cases of permeable, contractile, and irritable strictures; in all cases of extravasation of urine in which perineal incisions are called for, and also, in long indurated strictures complicated with urinary fistulæ.

6. *Perineal section*, Wheelhouse's or Cock's operation, is good in all cases of impermeable stricture or obliterated urethra, complicated or not with urinary abscess or fistula, in which a free outlet for the escape of urine is essential.

7. *Internal urethrotomy*, except in penile or in the obstinately irritable or contractile strictures, is not often required, and the treatment by caustics is dangerous.

8. *Cicatricial strictures* should be treated as others; but they are far more obstinate, and require more frequently external urethrotomy.

ON RUPTURED URETHRA.

The secondary effects of an injury to, or a rupture of, the urethra have already been considered under the head of traumatic stricture; and it has been shown, that in at least 6.65 per cent. of the cases of organic stricture, an injury was the assigned cause. It has also been shown that the worst and most intractable cases of stricture, as well as the majority of examples of obliterated urethra, are of this kind.

I propose now to consider the subject of ruptured or injured urethra with its immediate effects and treatment. In the majority of instances the injury is caused by some direct violence applied to the perineum, such as a fall astride a post, plank, fence, or chair, a blow or kick on the perineum. In not a few instances, the injury has been produced by the passage of a cart-wheel across the pelvis, though it may be somewhat difficult to understand how such a result can be produced by this cause, unless some fracture of the pubic portion of the pelvis coexists; but explain it how we may, in practice we meet with cases of ruptured urethra following the passage of a wheel across the pelvis, and unconnected with any other distinct evidence of fracture.

The characteristic symptom of a rupture or laceration of the urethra is the passage of blood, which appears usually as an immediate result of the injury, which may be little or profuse in quantity, although it seldom endangers life, and, as a rule, subsides without treatment. If the injury has not been severe, it is just possible that this is the only symptom by which the laceration can be recognized; and if some time has elapsed between its receipt and the calls of nature to relieve the bladder, micturition may be completed with little or no difficulty, and convalescence re-established.

It is not often, however, that the subject of a lacerated or ruptured urethra escapes so easily, for in the majority of cases retention or extravasation of urine is the result, and for the relief of this the advice of the surgeon is generally at once sought.

When called to attend a patient who has been the subject of an injury to the urethra suffering from simple retention, the first object is to attempt the passage of a catheter; and, if the urethra be not completely torn away and there is not much blood locally effused, there is a strong probability that he will succeed. Having accomplished this, the instrument should be fastened in and the urine allowed to flow away as secreted, being conducted at once by means of a tube into a vessel placed close at hand; for, if the catheter be plugged, urine is sure to find its way by its side into the perineum; consequently a gum-elastic or vulcanite instrument, with a strong stylet, should be employed. If the attempt at catheterism then fail, some other means must be employed to provide an outlet for the urine, as extravasation, with all its danger, will necessarily follow. Under these circumstances an incision into the perineum on a grooved staff is unquestionably the soundest practice to adopt; as by this means the extravasated blood and urine find a ready outlet, and the bladder when it contracts, a vent for its contents—the danger of extravasation of urine being prevented.

When the perineum has been laid open and the two ends of the divided urethra can be made out, they may be brought together by a suture; and, if the orifice of the vesical end of the ruptured urethra can be found with a grooved probe, a catheter should be passed, the instrument having been first introduced through the penis, and subsequently guided upon the grooved probe into the bladder. If difficulty is experieneed in finding the orifice, there need be no alarm, as it is quite clear that the urine will readily find its way externally through the artificial wound; nevertheless, an early attempt to pass the catheter should certainly be made, as it is most important that the continuity of the urethra should be restored as early as possible.

When a catheter has been introduced, it must be left, since it is important that the patency of the canal should be maintained *during* the whole period of its repair, and its subsequent contraction in a measure neutralized. The frequent passage of an instrument *after* the repair has taken place is an important point to be observed, this practice being the best guarantee that a cicatricial stricture cannot ensue.

In the case of a man I treated seventeen years before for retention following a ruptured urethra by a perineal incision, there has not since been any difficulty in micturition.

RETENTION OF URINE.

When a patient is unable to pass his urine, he is said to be the subject of retention, which may be due to the presence of organic or cicatricial stricture, spasm of the urethra, urethral obstruction from inflammation of the urethra or prostate, urethral calculus, and many other causes. I have already stated, that retention existed in 129 out of 608 cases of organic stricture admitted into Guy's during seven years; and in 5 out of 43 cases of traumatic stricture. It was also present in 80 other cases, the result of varied causes unassociated with stricture.

Spasmodic stricture was the assigned cause in half, *i. e.*, it was found in subjects in whom no permanent narrowing of the canal existed. In almost all, excess of drinking, with or without exposure to wet and cold were the exciting causes, and no complication aggravated the cases. One was in a boy, æt. 10, who paid the penalty of a drinking bout by suffering the pain of a retention. Catheterism relieved him. In all these forty cases, spasm of the muscles of the urethra was the assigned cause.

Retention in a child is generally from stone impacted in the urethra; in an adult, from stricture; and in an old man, from prostatic disease.

Spasmodic Stricture as a cause of Retention.

The existence of a *true spasmodic stricture* is no longer a subject of doubt. That the seat of the stricture is the membranous portion of the urethra, which is encircled by muscles, is also now generally acknowledged; and, that the usual exciting causes are xposure to wet or cold, and excess in drinking, many cases before me clearly prove. nything, however, which can induce an altered or acid state of the urine is likely to be ollowed by this complication, gouty and rheumatic patients being particularly liable to uch attacks. The *treatment* of such cases is not difficult; the simple passage of a large metallic catheter being the most expeditious and certain practice. The instrument should be well warmed and freely oiled, and then passed slowly, so as not to excite alarm or increase the spasm of the muscles. In skilful hands its introduction is not an operation of difficulty. If, however, the operator be foiled in his endeavors, he must be cautious not to employ force, which is never required and never justifiable. *Chloroform* should then be administered, and with a patient fully under its influence, all obstruction ceases, while the instrument will pass into the bladder. If there be an objection to the use of the anæsthetic, the old remedy of *a hot bath* cannot be too highly extolled; few patients suffering from simple retention failing to micturate when thus immersed; and the introduction of a catheter, moreover, is much facilitated. *A full opiate* is also an invaluable remedy, relieving the involuntary contraction of the bladder which is so painful in cases of retention, and thus removing one of the most constant causes of spasmodic stricture. The value of opium in these cases, according to some, cannot be upheld too strongly, indeed they assert that there is no case of retention of urine which will not yield to its benign influence, allowing either a natural relief or the introduction of a catheter. I am not disposed to go quite so far in this opinion, although the evidence of experience is generally in its favor, and, in cases of retention, it acts sometimes as a charm. The inhalation of chloroform I believe to be a preferable remedy—its action being more rapid and certain. If failure follow the application of these, other measures must be adopted; and without doubt, the simplest, safest, and most expeditious practice is puncturing the bladder through the rectum. In a simple spasmodic stricture, however, such a necessity can scarcely arise.

Inflammatory Stricture as a cause of Retention.

It has been already shown, that in spasmodic stricture, exposure to wet or cold, and an altered condition of the urine produced either from excess of drinking, gout, or rheumatism, are the chief exciting causes of an attack of retention; and if this be true, there can be no difficulty in understanding that a like result may be brought about, and is more liable to be experienced, if the urethra itself should be the seat of an inflammatory action. Retention of urine occasionally comes before our notice as a result and concomitant of gonorrhœa. The causes of the retention are evidently compound, viz. spasmodic stricture added to the mechanical obstruction produced by the œdema of an acute inflammation combining to produce the result.

The *treatment* required to afford relief must be based upon the appreciation of these two conditions which have combined to cause the effect. The retention is in a measure mechanical, and must be met by mechanical treatment; but it is also functional, and, as a consequence, must be so considered.

The symptoms being urgent, time is, therefore, a great object; and if called to a case, there are few surgeons who would not at once attempt to pass a catheter. Let the surgeon choose an instrument of medium size, No. 4 or 5 being the best, taking care that it be well warmed and oiled, and then with gentleness and yet with firmness the obstruction may be overcome; *arte non vi* must be the guide to action, as force is to be condemned as much in these cases as it was in the preceding.

If these means fail, a hot bath and a full opiate are the soundest remedies. They relieve the local turgescence of the passage, and also the obstruction, and with it the associated spasm. In some instances the introduction of a piece of ice into the rectum serves a like purpose. The use of chloroform in these cases cannot be recommended, as it merely relieves the spasm but does not alter the condition upon which the spasm depends, viz., the inflammation. When these means fail, which is not commonly the case, some operative measure may be required, which will be dwelt upon in another page.

Retention of urine following a blow in the perineum.—Under this heading it is not my intention to allude to cases of ruptured urethra, as this condition has already been considered. But cases of retention occasionally come under notice which follow a simple contusion in the perineum. I possess three such records—two in children aged three and seven respectively, and one in an adult aged twenty-nine. In none of these cases could hemorrhage or other symptom of ruptured urethra be made out. The retention followed the contusion, and was caused by some spasmodic condition of the passage excited by the injury. In all the cases, the simple passage of a catheter was the only treatment, and, with the relief of the symptoms convalescence followed.

Retention of urine from the pressure of an abscess in the perineum must be mentioned, as cases of retention from such a cause occasionally come under notice, while abscess about the rectum is not unfrequently associated with such a difficulty. It should be treated by opening the abscess.

Paralysis of the bladder from any cause situated either in the organ itself or associated with spinal disease, is a common cause of retention, and the same complication may be found with fever or any other constitutional condition in which the vital powers of the patient have been much reduced, and the nervous system has, as a consequence, become unable to answer to its accustomed stimulus. Retention of urine is also met with as a symptom of peritonitis, local or general, from traumatic stricture, or, as a result of some other abdominal disease. To prevent any error being perpetrated, however, it is enough for the surgeon to remember, that this complication may be produced by the causes enumerated.

It is not to treat retention of urine, however, that the surgeon is usually called to such cases. An incontinence of urine is generally the form of malady which attracts notice, and from this the surgeon rightly infers that a case of severe retention of urine is before him, the incontinence being merely the overflow of an already overdistended and engorged bladder. The symptom of incontinence is a very positive one, and should never mislead any practitioner. It is almost always a concomitant and result of retention, and should be so regarded, at any rate until the surgeon has convinced himself, by a careful examination, that the bladder is not distended.

Retention of Urine as a symptom of Enlarged Prostate, and in the Aged.

It has been a common opinion held by all surgeons for many generations, that an enlarged prostate is a very general condition of old age, and retention of urine, as a consequence and symptom of this affection is of frequent occurrence. The investigations of recent pathologists have shown, however, that such an opinion is by no means correct; for although an enlargement of the prostate, either as an hypertrophy, or from the development of independent prostatic glandular tumors may take place, and, when it does, it is most commonly met with in old people, yet such a condition is by no means to be considered as a senile change.

When retention of urine takes place in old people in whom no stricture exists, it is too frequently ascribed to this chronic enlargement of the prostate, and as it is really a rare thing to find such a condition in the bodies of those that die, it is fair to believe, that this retention is due to other causes, such as atony of the bladder, which may be relieved by the introduction of a large catheter. This operation should always be undertaken with great care, as an injury to the prostate or bladder in old people is of considerable consequence. An elastic instrument with a full curve, in the hands of those who are not in the constant habit of using instruments is to be preferred, and this may be passed slowly down to the neck of the bladder. It is at this point that the difficulty in its introduction is always experienced; but if the index-finger of the left hand be introduced into the rectum and the end of the instrument tilted upwards by the slightest pressure with the right hand, the catheter, as a rule, will be readily passed onward, and relief secured.

Retention of urine may also be produced by an abscess situated in the prostate gland, and the retention is only relieved when the abscess has been opened. This treatment, therefore, is that which should be followed.

Retention of Urine as a result of an Elongated and Adherent Prepuce.

It is a somewhat inexplicable fact that surgical writers have, with rare exceptions, omitted to notice that an elongated prepuce and adhesion of the glans penis to its mucous membrane covering, is capable of producing retention of urine with every symptom of vesical irritation; yet few surgeons can have had much experience at any hospital or dispensary, particularly in out-patient practice, without seeing many such examples. I could quote cases in which an adherent prepuce had been the cause both of retention and of incontinence of urine, and in which it had produced symptoms of irritable bladder and every other symptom of vesical calculus, even hæmaturia, prolapsus recti, or constant priapism.

All, or nearly all these cases take place in early life, and I never see a case of vesical irritation in a male child without first examining the condition of the penis. I have been in the habit of pointing out this fact to students for some years, and have advised them to follow the practice suggested under the conviction, that in at least two-thirds of the cases suffering from urinary irritation which pass under observation, an adherent and elongated prepuce is the sole cause. Circumcision and the careful separation of the prepuce from the glans penis, with the removal of the confined secretion of Tyson's glands, is the only remedy, which is at once simple and complete.

Retention of urine as a symptom of ruptured urethra has already received attention in another page.

On Retention of Urine from Organic or Cicatricial Stricture.

Among the many contingencies to which a patient suffering from organic stricture is continually exposed, none cause more agony and alarm, or demand more prompt and decisive action on the part of the surgeon, than retention of urine.

The retention may be the result of a slowly contracting organic stricture; but it will probably be produced by some sudden accession of spasm of the muscles of the passage, and thus be compound in its nature, a spasmodic being grafted upon an organic stricture. The symptoms, however, are necessarily urgent, and it becomes an important question as to what practice should be pursued. With this object, it will be of interest to inquire, first of all, what practice has been proved of value? and, as a means to the solution of the difficulty I can show, that out of 129 consecutive examples of retention from simple organic stricture, 109 were successfully treated by means of catheterism, warm baths, and opium. In 20 cases only, or 15·1 per cent. were any other operative measures called into requisition, and in all these 20 examples, the bladder was punctured per rectum with complete success.

Out of 8 cases also of retention of urine produced by the gradual contraction of a *traumatic* stricture, 5 were treated by means of catheterism, and 3 by puncture of the bladder. The proportion of cases requiring such an operation, being much greater in traumatic strictures than in the preceding class of simple organic stricture; the cause of this difference being very apparent.

If a surgeon is called to a patient suffering from retention of urine produced by either a simple spasmodic or an inflammatory stricture, it has already been explained that relief can be obtained by the cautious introduction of a catheter, aided, if required, by the use of the warm bath or a full dose of opium, and, in certain cases, by the inhalation of chloroform. If these means fail, as experience proves may be the case, either from some peculiarity of the stricture, or the manner in which the treatment has been carried out, other measures will necessarily be called into requisition; and it has been already stated, that the best and most expeditious practice is to puncture the bladder through the rectum. It is true that this practice is rarely needed in simple spasmodic or in inflammatory stricture, for the means already suggested are, in the majority of cases, amply sufficient to secure relief; nevertheless, in exceptional instances, this operation is of great value. It must be remembered, also that the practice is only required when simpler means have failed.

Since the introduction of the "aspirator," many surgeons have employed it with success in cases of retention, but relief by such a measure does not commend itself to my mind, being merely a temporizing operation, and requiring frequent repetition in the same case; it has no such influence for good upon the cause of the retention as the operation of puncturing the bladder through the rectum. But in exceptional cases of retention of urine it may be a justifiable proceeding.

In the treatment of retention of urine with simple organic or traumatic stricture, the same principles of practice should be applied as have been recommended in the former class of cases; and in a large proportion of instances it has been already shown that success by such treatment may be secured; since, out of 137 cases of retention admitted into Guy's, operative measures were required in only 23, and the simple introduction of a catheter with the aid of warm baths and the internal administration of opium, proved sufficient to carry out all the objects required in 114. If the surgeon is called, therefore, to a case of retention of urine with organic stricture, the introduction of a catheter is the primary means to be employed. If the history informs him that the retention is the result of a gradually contracting passage, a medium-sized instrument should be selected, and on this failing, a second attempt with a smaller one may be followed by success. Force, however, must not be employed, and too much time should not be expended in making the attempt. If success is to follow the operation, it will readily be obtained; perseverance and repeated endeavors to pass an instrument, as a rule, do harm. If the symptoms are not very urgent and some delay may be allowed, the warm bath and a full opiate, such as two or even three grains of opium may be employed; and, under their combined influence, it will be only in exceptional cases that relief will not subsequently be secured.

If the symptoms of retention, however, are very urgent, and the agonies of the sufferer demand immediate relief; or, if the means which have been just described have been found wanting after a fair trial, there is little doubt that the most scientific and certain practice is the puncturing of the bladder through the rectum; for all experience has correctly endorsed the opinion expressed by Mr. Cock when he recalled the attention of the profession to this operation in his valuable paper published in 1852 (vol. xxxv of the 'Med.-Chir. Trans.'), "that the bladder may be reached with the smallest amount of pain, with the least risk of present or future danger, and with the greatest prospect of ulterior good, by puncture through the rectum."

The records I possess of the cases of this operation, positively prove the truth of this opinion, and it is gratifying to find that, in these days, the majority of surgeons recognize the value of the practice.

The operation is as simple as it is safe, and as efficient as it is scientific. As a means of relieving a patient from the agony of retention of urine which has been proved to be irremediable by the *rational* use of catheters, it stands unrivalled. By its adoption all forcible catheterism with its dangers is avoided. Perineal section and its difficulties as a remedy for retention, are done away with, and the operation for puncturing the bladder above the pubes may nearly be forgotten. Puncturing the bladder through the rectum embodies in itself all the advantages of these means without any of their evils; and on practical grounds commends itself for our adoption.

I would add, therefore, as a final conclusion:—"That in all cases of retention of urine from stricture in which relief cannot be given by means of rational and not forcible catheterism, and in which the use of the warm bath and opium have failed, the operation of puncturing the bladder through the rectum should be performed."

ON PUNCTURE OF THE BLADDER PER RECTUM.

In all cases of retention of urine in which relief cannot be afforded by the introduction of a catheter, and the nature of the obstruction is not such as to require the operation of urethrotomy, puncturing the bladder through the rectum is the right operation to perform, as by it relief can be given with rapidity, certainty, and safety.

In former times, the bladder used to be punctured with a full-sized trocar and canula from the perineum, but such a clumsy operation is not now recognized among surgical proceedings, though with the aspirator, the same proceeding has been often undertaken. At the present day, some surgeons prefer tapping the bladder above the pubes, but in safety and efficiency the operation is not to be compared with that which I now recommend, for, in the words of its modern advocate, Mr. Cock, "The operation is safe, easy of accomplishment, and without danger as to its consequences. In cases of retention which resist ordinary treatment it is greatly to be preferred to the long-continued attempts at catheterism, which, whether successful or not, must be infinitely more injurious to the urinary organs than the simple and almost painless operation of tapping."

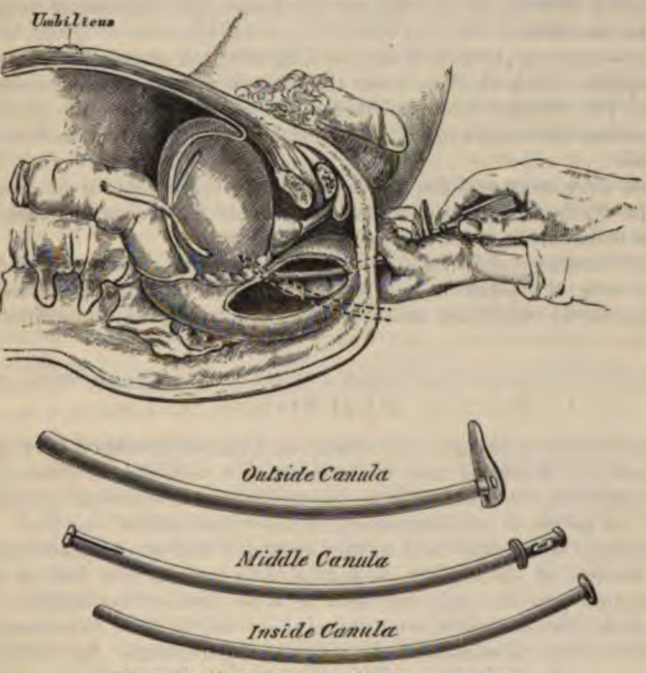
"I consider," writes Cock, "that the benefit of the operation consists, not merely in the immediate relief given to the patient, but also in the opportunity which it affords, by the retention of the canula in the bladder through an indefinite period, of diverting the flow of urine from its ordinary channel, and thus giving quiet, freedom from pain, and the natural means of restoration to the maimed, irritable, or diseased urethra. I conceive also that the bladder might be tapped with advantage in cases of obstinate stricture, in which retention of urine does not actually exist."

These views, published by Mr. Cock in 1852, 'Med.-Chir. Trans.,' and 'Guy's Reports,' 1866, I cordially endorse. The practice of Guy's Hospital for the last twenty years, to my knowledge, has only confirmed their accuracy, and, the more I see of the operation, the more I like it. The objections raised against it are theoretical and not practical, for abscesses between the bladder and rectum, persistent fistulous openings, injury to the seminal vesicles, and wounds of the peritoneum, do not commonly occur. They are said to have done so in exceptional instances, but must, indeed, be very rare. Mr. Cock, in his large experience, has known but one bad result to follow the operation, and that was atrophy of the testicle, from which he infers that the vas deferens was wounded. At Guy's, from the carelessness of a house-surgeon, a fatal peritonitis from the perforation of a coil of intestine once followed the operation, the puncture having been made too far back; but eliminating carelessness, a cause of half the errors in surgery—the operation is very safe.

The only requisite is a moderately full bladder, a feature almost always present under the circumstances which call for the operation. An enlarged prostate is no real obstacle to its performance, since it may be perforated with impunity.

The Operation.—The best instruments are those suggested by Mr. Cock. The long curved trocar and canula as originally employed, are inefficient instruments; indeed, many of the objections to the operation are, probably, traceable to their use. Cock's instruments consist of a canula, six and a half inches long, a blunt pilot trocar, and a sharp trocar; a second tube, with an expanding end to keep the canula in position; and a third to maintain the second in position. (Fig. 368.)

FIG. 368.



Operation of puncturing the bladder per rectum.

The patient should be placed and held in the position for lithotomy, and brought well to the edge of the bed. The operator must then introduce the index-finger of the left hand into the rectum with the palm upwards to feel for the prostate (Fig. 368), and, if possible, for the bulging base of the tense bladder beyond. Some little pressure above the pubes may help in this attempt. The pulpy point of the index-finger is then to be held in the median line just below the spot at which the puncture is to be made. The surgeon then with his right hand is to take from his assistant the canula, well oiled and fitted with the *blunt* pilot trocar, and to introduce it into the rectum upon his left index-finger, passing it well up to the point selected for puncture. He should then steady the canula and hold it firmly in position with the thumb and three outer fingers of his left hand, and withdraw the blunt trocar. The *sharp* trocar can then be introduced through the canula, and, having reached its end, the handle with the canula is to be depressed and driven home, in a direction upwards and forwards, *in a line towards the umbilicus* (dotted line, Fig. 368). The bladder in this way will be entered, the free end of the instrument moving freely, and all resistance ceasing. The trocar should then be withdrawn, and the canula pressed well home. Before the bladder is completely emptied, it is well to insert the two inner canulæ, and fasten the whole in by means of tapes, two passed in front and two behind the thighs, to a girth round the waist. The canula may then be plugged with a peg to retain the urine, or with a hollow plug inserted into a piece of india-rubber tubing, through which the water may drain away.

As soon as the urethral passage has become pervious to the catheter, *but not before*, the canula should be withdrawn; this condition taking place usually within a week from the introduction of the catheter. The stricture may then be treated on rational principles by dilatation. It is very remarkable how, at times, a stricture which has been thus left alone and unirritated by catheterism or ineffectual natural efforts at micturition, gives way under such treatment, and a thoroughly impervious indurated urethra becomes pervious and amenable to simple measures.

The wound into the bladder closes rapidly after the removal of the canula, even after many weeks; and, in a case of my own no urinary fistula followed the presence of the canula for seven weeks.

In retention of urine from enlarged prostate such an operation as this is rarely called for; yet at times it is necessary. I have had recourse to it on three occasions where the neck of the bladder and prostate gland had been seriously injured from rough catheterism, and with such good success that I shall never hesitate to repeat it when any difficulty exists in entering the bladder, or, in subsequently keeping an instrument in the bladder. In two of the cases mentioned, the irritability of the bladder was so great as to resent the presence of an instrument, and the pain and difficulty in its passage were so severe as to be nearly unendurable. In both these cases the operation was followed by speedy and permanent relief. The bladder recovered its healthy condition after the parts had had rest for a few days, the urethra allowing of catheterism without distress, and convalescence was soon established.

The surgeon, then, may perform this operation without fear in all cases of retention where any difficulty in catheterism exists. I know of no operation attended with equal good, that is so safe, satisfactory, or free from danger.

In all cases of supposed retention of urine, the surgeon should guard himself against falling into the error of mistaking suppression for retention; as in all cases of supposed incontinence he should remember that it may be due to retention and overflow.

Extravasation of Urine in Children and Retention from Impacted Urethral Calculus.

It has been already explained how retention and extravasation of urine in the *adult* may be produced by the mechanical obstruction of a urethral stricture. It remains to show how, in children, the same effects ensue from a mechanical obstruction of a very different kind. I allude to the obstruction caused by a urethral calculus.

A vesical calculus when small and ejected from the bladder may become lodged or impacted in any portion of the urethra, and, as a consequence, give rise to every degree of difficulty of micturition, even to a retention of urine and extravasation. And although in adult life I have seen complete retention, I have never seen extravasation occur as a result of impacted urethral calculus. In infancy and childhood, however, almost all the examples of extravasation of urine that have passed under my observation have been the product of such a cause; I have seen it in an infant fourteen months old, and in many others older.

When a case of retention in a child comes under notice, and there is no phimosis, paraphimosis, or adherent prepuce by which this symptom may be produced, a strong probability exists that a urethral calculus is the cause. Indeed extravasation of urine in childhood is almost invariably the result of an impacted calculus, the impaction commonly taking place in the perineum, the stone rarely passing into the penis.

TREATMENT.—If the calculus can be removed by forceps carefully used, this practice is the right one to adopt; it is, however, rarely successful, and, where these means fail, the stone must be excised. When extravasation has taken place, the urethra must be opened in the perineum by a free incision upon a grooved staff. The stone is sometimes lost in the sloughing tissues.

By way of summary of the causes of retention it may be stated that retention in a *male child* is usually due to a urethral calculus, phimosis, paraphimosis, adherent prepuce, or the mechanical obstruction caused by a piece of string, &c. In a *female*, to ulceration about the meatus, or to adherent labia. Retention in the *young adult*, to stricture, obstruction of the urethra from stone, gonnorrhœa, perineal, anal, prostatic abscess, or rectal disease. In the *aged*, from enlarged prostate or atony of the bladder.

Retention from fever or general nerve shocks may occur at all periods. In women, hysterical retention may also occur, as well as retention from other uterine causes.

CHAPTER XXIV.

AFFECTIONS OF THE GENITAL ORGANS.

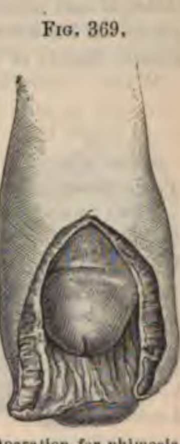
THERE is probably no part of the body which varies more in its conformation than the penis, or one in which any congenital defect is more likely to be inherited. The elongated and contracted prepuce is particularly hereditary, and all the male branches of a family may be the subjects of it. I have known this to be the case in many instances, and, in one family, five sons suffered from it, as well as their father.

Phimosis, or a condition of prepuce which, either from narrowness of the preputial orifice, or adhesion, cannot be retracted behind the glans, is, therefore, a *congenital* affection, but as often as not an *acquired* one—the result of inflammatory thickening and contraction subsequent to a preputial chancre, or other affection.

So long as the prepuce is only long and the glans can be uncovered for purposes of cleanliness, and during erection, operative interference is not called for, though it is well to impress upon nurses the necessity of paying attention to the infant's penis, and of cleaning it daily; since a want of such attention is frequently the source of urinary trouble and penile irritation. When neglected, the secretion of Tyson's glands collects behind the corona, and acts as an irritant; the prepuce and glans penis constantly becoming adherent, and setting up bladder irritation simulating the symptoms of stone. In some neglected cases, an acute inflammation is induced, followed by œdema of the prepuce and the secretion of pus, which suspicious minds have too often interpreted as gonorrhœa, much to the injury of nursemaids and others in whose charge the child rested. This disease is essentially a balanitis, and easily cured by cleanliness. In the adult, a long and narrow prepuce is injurious, as being a bar to proper cleanliness, and interfering with coitus or rendering it painful. It is also probably an exciting cause of cancer of the organ, where a disposition to such an affection exists. In boyhood, it probably by setting up an irritation in the parts induces a habit which ends in masturbation. It often gives rise, moreover, to incontinence, and may produce retention of urine. Dr. Lewis Sayre, of New York, has also pointed out in his work on 'Orthopedic Surgery,' 1876, that as a direct result of this condition of the prepuce, talipes, paralysis, and other nervous affections may take place, the talipes being due to muscular contraction of the lower extremities owing to reflex nerve irritation; and paralysis, as a consequence of the nervous exhaustion caused by the undue genital excitement which is often associated with this condition.

TREATMENT.—When the narrowing is not great, the daily retraction of the prepuce over the glans for purposes of cleanliness is generally sufficient to dilate the orifice, care being taken to replace it subsequently. Dr. Cruise's plan of dilating the orifice mechanically is not satisfactory; I have given it a trial and rejected it. The suggestion also of making two partial lateral sections of the mucous membrane has in my hands met with the same fate. Neither of these methods is so successful as to warrant its being recommended.

FIG. 369.



Operation for phimosis

When phimosis exists, congenital or otherwise, it is, as a rule, best treated by circumcision. In exceptional cases, where a narrowing of the prepuce is more marked than an elongation, the prepuce may be slit up (Fig. 369), but in children circumcision is the better operation. In some instances, however, where the penis is very short, the fault resting more in the penis itself than its skin covering, circumcision should not be performed, for I have known, under these circumstances, the operation to fail, even when well done; in such cases the prepuce should rather be slit up to the corona and its mucous covering turned well back and fixed to the skin.

In minor cases the *slitting* plan should be carried out; the skin and its mucous lining being divided in the middle line either by the introduction of a bistoury guided by a director beneath the prepuce, or by means of a pair of sharp scissors. The surgeon must be careful in doing this, to divide the mucous membrane *right back to the corona.* In the adult he should then turn the two flaps backwards, and fasten the mucous to the skin flap by means of some fine sutures. In the infant there is no necessity to stitch. When the prepuce requires division to expose a sore or some warty growth, the above plan should be selected.

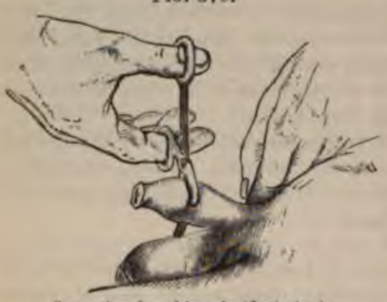
CIRCUMCISION

is an operation which requires great nicety, for it fails if sufficient skin is not taken away and the mucous covering of the glans is not fully divided up to the corona, and it does not turn out well when too much skin is removed. The following is the plan I have for years adopted and taught, and have never known to fail if properly carried out :—

The first point is to decide how much skin is to be removed, which can satisfactorily be determined by applying a pair of long dressing forceps to the penis, which should be allowed to rest in its natural position, on a level with its corona, and closing them as soon as the glans penis has been allowed to slip backward. The integument in front of the forceps may then be amputated with a scalpel (Fig. 370).

The forceps should now be taken away and the mucous covering of the glans be divided in the middle line, well up to the corona (as in the slitting operation) and turned backwards, the two flaps being stitched to the skin by fine sutures. In adults, a fine uninterrupted suture is probably the best; in infants, a strip of dry lint wrapped round the parts is all that is necessary.

FIG. 370.



Operation for phimosis (first step).

The glans penis in both these operations should be completely separated from its mucous covering, all secretion removed, and the frænum divided when short.

By adopting these suggestions the student has a definite guide to aid him in the removal of the skin; whereas if the end of the foreskin be drawn out as usually recommended, he has none.

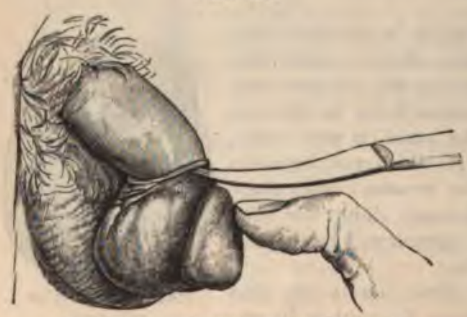
Paraphimosis is said to exist when a tight prepuce which has been retracted behind the glans cannot be replaced, and as a consequence a strangulation of the glans, and mucous lining of the prepuce with œdema takes place, and at a later period ulceration in the line of strangulation, and even sloughing.

In children, it follows the accidental retraction of a narrow prepuce, and in adults, the mechanical retraction of the prepuce during coitus, and the neglect to reduce it. It may be associated or not with some venereal complication.

TREATMENT.—The object of the surgeon should be to reduce the glans behind the narrow prepuce by which it is strangulated; and, failing this by simple means, he must divide the constricting preputial orifice so as to effect this end.

To carry out the first object, which can be done, as a rule, in recent cases both in children and adults before the œdema is great, chloroform should be given and the patient placed on his back. The surgeon should then take the penis between the index and the middle fingers of his two interlocked hands, and while thus pulling the prepuce forwards forcibly press the glans backwards with his two thumbs, the pressure of the thumbs, and counter-pressure with traction of the interlocked fingers so displacing the fluid from the œdematous tissues as to allow of the reduction of the paraphimosis. When the œdema is very great, a few needle or lancet punctures facilitate the operation. An india-rubber band applied as an Esmarch's bandage will sometimes answer. When the affection has been of some days' standing and ulceration exists, and, when failure has followed all attempts at reduction, the strictured preputial orifice must be divided; but the band must not be looked

FIG. 371.



Mode of dividing prepuce in paraphimosis.

for behind the glans, but behind the roll of œdematous prepuce that surrounds it. This is best done by a cut, half an inch long made with a scalpel in a vertical direction over the constriction, the thumb of the left hand forcibly depressing the glans penis. (Fig. 371.) The prepuce at times yields audibly and the wound gapes; the whole constricting medium should also be divided. Water dressing, or, some lead lotion should be applied to the parts subsequently to assist recovery. After the paraphimosis has been reduced and the œdema subsided, it is wise in the case of children to circumcise, and in the adult the same practice is frequently desirable. In all cases of *œdema of the penis* in children, the surgeon must remember, that it may be due to mechanical strangulation by string.

Warty growths are very common on the penis, and they may be found fringing the orifice ot the prepuce, and the urethra, or growing from any part of the mucous membrane between the two points; indeed, they may grow from within the urethra as well as from the outside skin of the prepuce. They have in the bulk of cases, a venereal origin, that is, they have been caught by contagion, for warts are contagious; but they, at times, occur without any such cause in men who have long prepuces, and who are not sufficiently careful in local cleanliness. When they are numerous, their excision is the only successful treatment, nitrate of silver being applied to their bases, but in less severe examples, the dry oxide of zinc, freshly powdered savine and calomel, are good local applications, the warts rapidly withering under their influence.

CANCER OF THE PENIS.

In the middle-aged and old, it is sometimes difficult if not impossible, to distinguish simple warty from cancerous growths; although the greater obstinacy of the cancerous and their disposition to bleed are probably the best points of distinction.

When there is ulceration the disease is probably cancer. If the cancer be left to take its course, the glans penis and prepuce become infiltrated and the warts discharge a fetid ichorous secretion, break down and ulcerate; the inguinal glans become involved, and death takes place from exhaustion. At times the whole organ is destroyed and the scrotum involved.

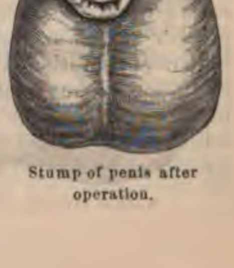
Cancer of the penis is generally of the epithelial variety, true carcinoma being comparatively rare.

TREATMENT.—In all clear cases of this disease, unless the inguinal or lumbar glands are extensively involved, amputation is the only sound practice to follow, and, in the doubtful, it is the wisest. When the prepuce alone is involved, the excision of the growth may be sufficient, but nothing less than amputation is of any use when the glans is affected. Under all circumstances, the surgeon should cut quite free of the disease, for the tissues about it are probably more or less infiltrated with cancerous products. I have a patient alive and well now (1878) whose penis I cut off for cancer eleven years ago, and a second, from whom I excised a cancerous mass from the prepuce, twelve years ago.

AMPUTATION OF THE PENIS.

Since the galvanic cautery has been in use, I have employed nothing else for amputation of the penis. The platinum wire should be passed round the penis and made tight with the écraseur screw. Connection with the battery must then be made, and the wire screwed *slowly* home, for, if the tissues are divided too rapidly, hemorrhage will take place. The heat should not be too intense. Under ordinary circumstances, the operation is absolutely bloodless, and the subsequent pain slight. After the penis has been removed, it is wise to slit the urethra open for about half an inch, turn its two edges outwards, and fasten them with sutures. This step may be done at the time of the operation or during the first week, and is necessary to prevent the contraction of the urethral orifice that may otherwise ensue. When the cautery is not to be had, the knife should be used, and the old operation consisted in the removal of the organ by one clean sweep of the bistoury, an assistant having steadied and compressed the base of the organ by a band of tape. The modern improved operation, which, I believe, was suggested by Hilton, consists in the introduction of a narrow bistoury between the spongy and cavernous bodies, and after dividing the latter, the spongy body with the urethra must be cut through about half an

FIG. 372.



Stump of penis after operation.

inch more forward. The object of this is to make the urethra stand out from the stunted organ, and thus facilitate micturition. It is without doubt the best mode of amputating a penis with the knife. To prevent any tendency in the urethra to contract, it may be slit open or stitched back to the preputial skin. Fig. 372 illustrates the stump after such an amputation.

To arrest hemorrhage during the operation, Clover's clamp for compressing the penis is very excellent, and ought to supersede the tape.

Other tumors of the prepuce.—The prepuce may be the seat of *fatty*, *sebaceous*, or even *fibrous* tumors, though these are rare. It is not uncommonly the subject of what has been described as *elephantiasis*, although when the penis is involved, the scrotum is usually similarly affected. I have, however, seen one case in a man aged thirty-five, where the penis was thus alone affected. The organ was immense, and frightful to look at. When in repose, it measured eight inches round and six long. The man came to me with a gonorrhœa; admitting, however, that he had never been able to have true coitus since the disease had existed, which was about four or five years.

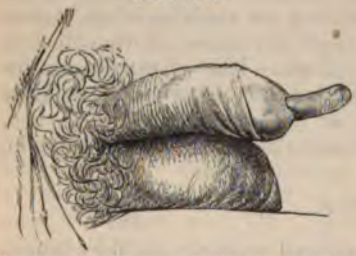
The disease is a chronic hypertrophy of the skin and cellular tissues. Nothing but the excision of the redundent integument is beneficial.

INJURIES TO PENIS.

These are not common, excepting such minor injuries as laceration of the frænum or prepuce, produced in coitus. Incised wounds, however, are occasionally met with, the products of insanity, jealousy, or malice; the parts require careful adaptation with sutures. The body of the penis at times, however, becomes the seat of injury from some rough bending of the organ during connection or otherwise; and, as a consequence, when the immediate effects of the injury have passed away, strange symptoms appear. Thus, some years ago, I was consulted by a gentleman whose penis, when turgid, arched laterally, the cavernous body of one side having atrophied and become a mere gristly mass. This condition had followed an injury received in coitus many years before. Some great induration had existed for months in the cavernous body that had subsequently atrophied.

More recently I have seen a married man, about 60, who a year before "missed his mark" in coitus, and hurt his penis; an induration followed, and at the present time where this existed there is a deficiency of tissue, and when the penis becomes turgid it is never straight, but bent laterally. A singular case of injury to the penis was seen at Guy's in 1867 in the practice of Mr. Hilton. It was in a man æt. 50, who, when nineteen, had had his penis bitten by a stallion; after the accident some little bleeding occurred, and a fleshy cylindrical body, an inch and a quarter long and one-third of an inch in diameter, projected from the urethral orifice. It was evidently the corpus spongiosum which had been divided by the horse behind the glans penis and had become everted. When the patient was admitted, the corpus spongiosum urethræ terminated abruptly about one inch behind the glans penis, and the urine flowed by the side of the protrusion. (Fig. 373.)

FIG. 373.



Corpus spongiosum projecting from urethra after injury.

MALFORMATIONS OF THE URINO-GENITAL ORGANS.

These malformations of the urino-genital organs are more common in the male than in the female subject, and show themselves in many degrees of severity. Thus, when the upper surface of the urinary passage from the orifice of the urethra to the fundus of the bladder is deficient, a case of *extroversion of the bladder* or *ectopion vesicæ* is said to exist; when the urethra alone is deficient at its upper part, *epispadias* is the term employed. Some authors apply the latter also to the more complete condition. With this imperfect condition, a separation of the pubic bones frequently exists, as well as some malformation of the scrotum, this sac being often bifid though containing the testicles in proper position. At times a hernia complicates the case. When no testes are present and the scrotum is bifid, the question as to sex often arises, for in the female the vagina is frequently absent, or so small as more nearly to represent a urethra than a vagina.

In extroversion of the bladder, the posterior wall of the bladder appears as a red mucous mass below the umbilicus which is lost in the upper border of the deformity. At the lower part of its surface, the orifices of the ureters may be often seen as small nipple-like projections; and in some instances, these orifices are lost in the pelvic chink, although they may be brought into view by depressing the fissured penis or what represents the penis, for this will probably appear only as an expanded glans penis and a pendulous prepuce. The cleft urethra, as it becomes lost in the pelvic fissure, can be made visible by pulling the parts down. (Fig. 374.)

In the female subject, the exposed urethra will be seen between the two labia. When the vagina is present, it will open at its upper border, and appear continuous with the lower labia. (Fig. 375.) At times, though very rarely, the epispadias involves only the urethra. I have seen but five cases of this peculiarity, and in all the exposed mucous surface of the urethra passed backwards towards the pubes into a fissure, which was covered in by a thin transverse fold of skin, from beneath which urine flowed. The scrotum was large but bifid, and contained the testes ('Guy's Hosp. Rep.,' 1868).

Fig. 374.

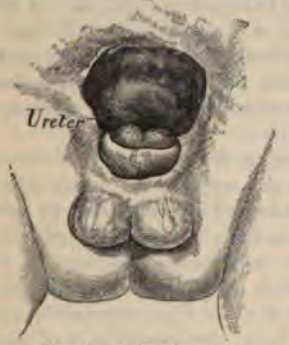
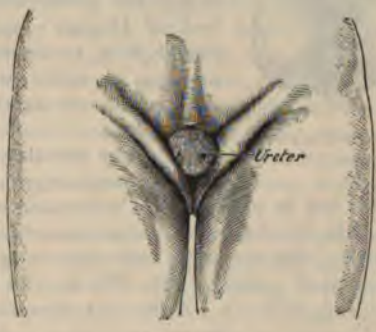


Fig. 375.



Ectopion vesicæ in male . . . . In female.

Treatment.—The chief annoyance connected with this deformity being due to the constant dribbling of the urine, Messrs. Simon and Lloyd were induced to carry out an ingenious operation by which the urine might be carried into the rectum and the fissure subsequently closed, but the attempt failed and has not been repeated. For particulars the reader may refer to the 'Lancet' (1851 and 1852). Holmes has suggested a modification of Simon's plan, and it is probably in this direction that some good may eventually be found.

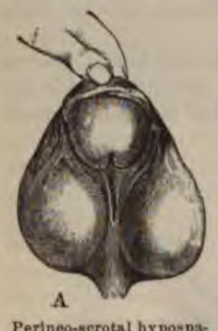
In a case of epispadias, in a boy, recently under my care (Sept. 1875), in which the whole of the urethra down to the neck of the bladder was fissured, and in which consequently there was incontinence of urine, I tapped the urethra in the perineum in front of the prostate, and established an artificial urethral opening. By these means the urine passed through the perineum instead of above the pubes, and consequently could be caught and retained in a urinal, greatly to the patient's comfort.

Other surgeons, however, have devised means by which the exposed mucous covering of the bladder may be covered in, thereby adding to the comfort of the patient; and of these Wood, of King's College, has been the most successful. He has operated in ten such cases, and Holmes in five. I have operated only in two. Four of Wood's succeeded completely; three of Holmes's; and one of mine, the others being partially successful. The operation consists in bringing up flaps of skin from either side of the fissure and covering it in, fastening them together by sutures. For full details, *vide* 'Med.-Chir. Trans.,' vol. lii, and Holmes's 'Surg. Dis. of Child.,' 1868. In one case I destroyed the mucous membrane with the cautery, and thus turned it into a cicatrix, avoiding the ureters.

Hypospadias is a term applied to any deficiency of the under surface of the urethra, and in the larger number of cases, the urethral orifice is placed below the glans at a spot corresponding to the preputial frænum. In some, a depression exists in the glans penis corresponding to the natural outlet with several small depressions between the urethral orifice and the cup-like depression at the extremity of the glans; while in others, one or more foramina are present, situated below the true opening of the urethra through which urine escapes. The urethral opening in these cases is often small and requires enlarging.

In more extreme cases the urethral orifice appears at the base of the penis, when the deformity is commonly associated with a bifid scrotum ; under these circumstances, when the testes are absent, the question of sex is raised. In a case of this kind that I saw in 1867, the sexual passion was so strong that the man came to me to ask for castration, as he was unable to copulate on account of the stunted condition of his penis, and the way in which it was held down by a band which caused it to arch downwards under excitement. The man at the time had testitis from ungratified passion.

Fig. 376.



Perineo-scrotal hypospadias.

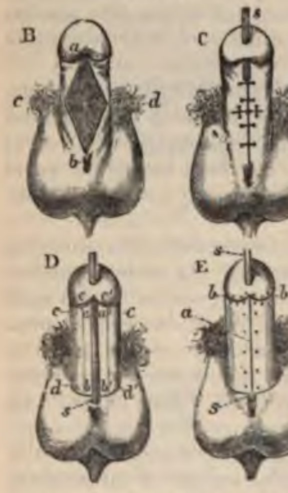
The operative measures that have been employed for the relief of this deformity have hitherto not been very successful, although recently ('Med. Times and Gaz.,' Jan. 30, 1875) Mr. John Wood has recorded two cases of the *balanic* or *penian* varieties in which relief was given, and M. Duplay has published full details of his method of dealing with the more advanced form of malformation, called the perineo-scrotal (Paris, 1874), Fig. 376, A. I think so well of Duplay's operation that I will describe it. It has for its object, *first*, to separate the penis from the scrotum and destroy its arching, in order to allow erection and coition ; and, *secondly*, to construct a new urethra from the abnormal perineal opening to the glans penis.

To carry out the first indication, a free division of the fibrous bands connecting the penis with the scrotum has to be made; and when this can be effected by a subcutaneous wound as adopted by Bouisson, so much the better. Duplay, however, incises transversely the tissues from without inwards, dividing, if necessary, the envelopes and septum of the corpora cavernosa; this incision leaves a lozenge-shaped wound (Fig. 376, B), the edges of which may be brought together by sutures (Fig. 376, C). After this operation, the penis is to be kept constantly stretched to guard against subsequent retraction, and six months later, the second part of the operation should be carried out.

The construction of a new urethra is a difficult matter, and must be carried out in stages. Duplay's method is divided into three.—1st. The restoration of the urinary meatus; 2d, the creation of the new urethra from the meatus down to the hypospadic perineal opening; and 3d, the reunion of the two portions of the urethra.

The *first stage* may be done at the same time as the correction of the arching of the penis, and consists in simply paring the edges of the glans penis and bringing them together by sutures round a catheter (Fig. 376, C). It is almost always successful.

Fig. 376.



Operation for perineo-scrotal hypospadias.

The *second stage* is to be effected in the following manner:—

The penis being held up, two longitudinal incisions are made on its inferior surface parallel to the median line, and extending from the glans penis to the perineal urethral opening, these incisions being bounded by two transverse ones (Fig. 376, D). Two quadrilateral flaps are thus formed (*a b*, *a' b'*), which should be large enough when turned back to cover a catheter that has been previously introduced into the urethra.

The cutaneous surface of these flaps should next be turned towards the catheter and the raw surface exposed to view.

The skin of the penis in continuation of the transverse incisions is then by a little dissection made to furnish two new flaps (*c d*, *c' d'*) for covering the raw exposed surface of the flaps.

Lastly, the lower edge of the glans penis is vivified in the part which corresponds to the new channel.

The flaps must now be united, their superior edges being stitched to the vivified glans and the two flaps on each side of the urethra, the superficial and deep, brought together with metallic or other sutures (Fig. 376, E).

The *third* stage of the operation consists in the reunion of the two portions of urethra, and should be effected by paring the edges of the hypospadic orifice and bringing them together by sutures deep and superficial.

After the operation the urine must be drawn off by means of a catheter, and the union of the part is usually completed after three or four days.

Puberty is the best period probably for the performance of this operation.

Occlusion of the urethra from some membrane or band sometimes exists, which if not broken down in intra-uterine life leads to dilatation of the bladder, sacculation of the ureters, distension of the pelvis of the kidney, and destruction of its secreting structure (*vide* cases by Morris, 'Med. Chir. Trans.,' 1876).

ON LOCAL VENEREAL DISEASE.

Urethritis, gonorrhœa, or clap, are terms applied to cases of inflammation of the urethra of every degree of intensity, and the product of a great variety of causes. In some, the affection is the consequence of the direct irritation of an instrument passed into or left in the urethra, while in others, it follows excessive sexual intercourse, or ordinary sexual intercourse with chaste or unchaste women who are out of health and suffering from acridity of the vaginal secretion. It is the direct product most commonly of contagion from the specific or other pus of an inflamed mucous membrane, Simon ('Holmes's System,' vol. i) having shown that "there is ample room to question the popular impression that only specific inflammations are communicable; much reason for suspecting it, on the contrary, to be a generic and essential property of inflammation, that its actions are always in their kind, to some extent, contagious, pus from an acute inflammation producing its kind on inoculation."

Lee states ('Holmes's System,' vol. v, ed. 2) the causes of urethritis to be the application of a gonorrhœal discharge to the sexual organs. Certain irritating substances applied to the mucous membranes, *e. g.*, menstrual fluid, leucorrhœal discharges, &c., and other irritants, such as the injection of a solution of ammonia, and some constitutional cause, such as gout or rheumatism.

It is well to bear in mind also Ricord's observation, "that gonorrhœa often arises from intercourse with women who themselves have not the disease;" and Diday's, "that from the very fact of a woman having a discharge, no matter what its origin, she is liable to give a discharge to a man. Complaints closely resembling gonorrhœa sometimes appear in persons the subjects of stricture, after sexual intercourse, a debauch, or other excitement.

The disease may be *acute* and come on within a few hours of connection, or, it may fail to show itself for five or ten days, and, in a general way, the sooner the symptoms appear after the contagion the acuter the disease. It may be *subacute* or *chronic*.

It generally commences by an itching about the orifice of the urethra, the mucous membrane of which will probably appear swollen and injected; there will be the sensation of heat on micturition, and, after the lapse of a few hours, some muco-purulent fluid will be squeezed out of the urethra. In acute diseases, the urethral discharge will soon become abundant, and yellow, green, or blood-stained pus will flow from a highly injected and swollen urethra; the whole glans and penis will become red, swollen, and painful; micturition will also probably be difficult, painful, and scalding, the passage being obstructed by the swelling of the mucous membrane. Chordee, or painful erections, as the disease advances, will appear, and later on perineal pain, if not suppuration. The groins, testicles, and perineum, too, become the seat of more or less tenderness; and constitutional symptoms show themselves varying with the degree of the inflammatory action, in some subjects the febrile condition being well marked, but in most absent. After the lapse of ten or fourteen days these acute symptoms partially subside, the discharge becomes thinner and more muco-purulent, the external signs of inflammation less marked, the pain on micturition less severe; the perineal, inguinal, or scrotal pain probably will have disappeared, and a thin muco-purulent urethral discharge with a slight sensation of heat on micturition alone remaining.

When these symptoms are allowed unchecked to run their course they will gradually pass into the condition known as that of *gleet*, in which a thin muco-purulent urethral discharge exists, unattended by any local or general source of pain. *Gleet*, however, may be the result of some stricture or local urethral disease, such as an ulcer.

The ordinary seat of the affection is the mucous membrane of the urethra, the orifices of the lacunæ being chiefly involved. The fossa navicularis and parts around, and the mucous membrane of the bulb are the most common seats; the dissections of Sir A. Cooper, Ricord, Thompson, and others, having proved this. At times, however, gonorrhœal inflammation may, as Wallace pointed out ('On Venereal Disease'), involve at the same time the whole of the urethra, the bladder, the testicles, the glans, and the prepuce, in the male; and in the female, the nymphæ, clitoris, vagina, &c., the disease, as it creeps along to the posterior part of the urinary passage, decreasing in intensity in the anterior. In severe cases the inflammation may extend to the submucous tissue, and run on to thickening, and even to suppuration.

Urethritis, the result of some mechanical irritation of the urethra, is rarely acute, and it, as a rule, subsides as soon as the cause has been removed. Urethritis, the consequence of some gonorrhœal contagion, is almost always acute, and having once been started is not readily arrested.

Gleet, whether the consequence of an acute or subacute inflammation when of some standing, is almost always due to some urethral contraction or stricture.

In the female, gonorrhœa is to be recognized as a yellow purulent vaginal discharge accompanied by heat, pain, and signs of acute inflammation. The less purulent it is, and the more the discharge is made up of mucus and epithelium scales, the greater is the probability of the disease being due to vaginal irritation other than gonorrhœal, that is, to leucorrhœa; and, when the discharge is made up of masses of glutinous, semi-transparent, albuminoid material like the white of egg, the more certain is it that the discharge is uterine and comes from the glands in the neck of the uterus.

It must be remembered, however, that in both sexes, as long as any purulent or semi-purulent fluid is poured out by the mucous membrane of the genital passage (even the slightest gleet), violent urethritis, or inflammation of the vagina, may arise in another subject by contagion, and there is good reason to believe, that sexual excitement is an important element in aiding the propagation by contagion. Mr. J. Morgan, of Dublin, believes, that the vaginal discharges of constitutionally infected women are the cause of the majority of sores in men.

TREATMENT.—Gonorrhœa or urethritis is a local disease and may be treated locally with success. When it is the result of local irritation from the passage of an instrument, no treatment is called for, the discharge ceasing naturally as soon as its cause has been removed, but when from gonorrhœal contagion, such a result is not met with.

In a very acute clap when the urethra and penis are swollen from vascular turgescence, free purgation with salines is the best practice, and, in plethoric patients, the addition of antimony in quarter-grain doses to excite nausea is most valuable.

In less severe cases, copaiba may be given in doses of twenty drops or half a drachm three times a day with advantage, but this drug should not be continued for more than three days. If it is to do good it will show its influence within that time, and a longer continuance of the drug is useless and deleterious. The yellow oil of sandal wood may also be employed in the same dose and under like circumstances, and at times, it acts most beneficially even when the copaiba has failed, but is in no way certain in its action.

Astringent injections are always of value when they can be used frequently and efficiently, but strong injections are to be condemned. They may cure the disease suddenly, but more commonly they fail, and set up inflammation of the bladder and other mischief, by adding to the irritation.

The best injection in all stages of the disease is tannin in the proportion of three to six grains to the ounce, and next to this is alum in the proportion of two or three grains to the ounce, or the chloride of zinc, one grain to the ounce. A solution of salicylic acid is also good, ʒss of the acid being dissolved in six ounces of water with a scruple of borax. To be of use injections should be used from four to six times in the twenty-four hours. An ordinary glass syringe will answer every purpose if the glans penis be well held, but there are special syringes which are supposed to have some advantages. During this treatment, the use of such alkalies as the citrate or tartrate of potash in twenty-grain doses, or ten grains of the bicarbonate may be given, good food being allowed, but little or no stimulant.

In the chronic stage, I have found great benefit from the introduction into the urethra of a large catheter covered with the glycerine of tannic acid; and, at times, the Suppositorium Acidi Tannici rolled into sticks and passed into the urethra, acts most beneficially.

The best way to give copaiba is as a bolus mixed with calcined magnesia, and wrapped in wafer paper, or, as a mixture with gum and peppermint water. The capsules are uncertain in their action. Copaiba is well known to produce in some patients a severe rose urticarious eruption. Cubebs are less to be relied on than copaiba.

In using injections, the object is to make an impression upon the mucous membrane by their astringent effects, and to keep it up. Weak astringents frequently employed are far more valuable than strong used at longer intervals. When so used they are as useful in gonorrhœal inflammations of the urethra as in that of the eye. When a man can devote himself to the cure of his clap, and throw into his urethra a weak astringent every hour, he will often check it within two or three days, in the same way as a gonorrhœal inflammation of the eye may be controlled under similar treatment. The nitrate of silver injection is an uncertain, and, at times, a dangerous remedy, adding often to the disease instead of diminishing it. In all cases of long-continued clap or gleet in the male, the presence of a stricture should be suspected. It may often be made out by the passage of a full sized *bougie à boule,* when an ordinary catheter fails to detect it. The gleet should only be satisfactorily treated by the cure of the stricture, that is, its full dilatation.

Tonics, particularly iron, are valuable adjuncts to the treatment.

All connection must be forbidden for some time after the apparent cure of a clap, for any sexual excitement is likely to be followed by a relapse. Drinking and smoking to excess are injurious.

In women, a clap is readily cured by the frequent use of astringent injections of tannin, alum, or zinc, ʒss to a pint; the passage into the upper part of the vagina of the tannic acid suppository is also excellent treatment. In the use of both these means the patient should lie down with her hips raised, and the astringent should be allowed to remain in the passage. To inject it sitting or standing is a useless, although too common a practice.

Complications.—In male subjects, inflammation of the *epididymis* is the most common complication, the disease, doubtless, spreading in a direct way from the urethra through the vas deferens and cord to the epididymis. In some cases, it stops at the cord; in others, it goes on to affect the testicle itself. It is often associated with hydrocele, and from this fact some surgeons have been led to believe, that inflammation of the testicle itself is a common consequence of a clap.

The treatment of this affection will be considered in a future page.

In the female, inflammation of the *ovary* is said to occur, and even *pelvic peritonitis.*

Abscesses in the cellular tissue external to the urethra, penile or perineal, are often met with in acute gonorrhœa, and should be opened early.

Chordee, or painful erection caused by the stretching of the corpora cavernosa into which inflammatory products have been infiltrated is a common consequence, and a very painful one. Full doses of opium (gr. j), or ten grains of henbane, and a like dose of camphor, are reliable remedies. Ricord used a suppository of ten grains of camphor and one grain of the extract of opium; I have sometimes thought the morphia suppository the most useful. Belladonna also smeared over the urethra gives relief at times.

Retention of urine may likewise occur from the mechanical closure of the urethra through its swelling, from spasm of the urethra, or from both causes. The warm bath and opium are the best remedies for the complication, a catheter being passed only when an absolute necessity exists.

Inflammation of the prostate is likewise a complication, as is also *inflammation of the bladder.* (*Vide* Chapter XXI.)

Inflammation of the inguinal glands or sympathetic bubo, is often present, the glands occupying the upper part of the groin being usually involved, but those below Poupart's ligament are not seldom affected. In neglected cases these glands may suppurate. Fomentations and tonics are the necessary treatment. The absorbents of the penis are at times inflamed and suppurate.

Balanitis.—When the glans penis and prepuce are involved in the inflammation, and this inflammation is attended with profuse discharge, *balanitis* or *external gonorrhœa* is said to be present. This affection may be due to want of cleanliness as much as to gonorrhœal contact. When the prepuce becomes œdematous and is long, *phimosis* takes place; when narrow and retracted behind the glands so as to be irreducible, *paraphimosis.*

This balanitis should be treated locally by astringents, such as the acetate of lead or the nitrate of silver lotion, v–vj grs. to the ounce, painted on the inflamed part, the phimosis and paraphimosis being treated on general principles.

It should be remembered too that a balanitis associated with a rawness or erosion of the glans or prepuce may be due to a syphilitic inoculation.

As a consequence of balanitis, *warts* are very common which may cover the mucous membrane of the glans and prepuce, or invade the urethra itself. They may grow to a great size, putting on much the appearance of a cancerous penis. I have seen them perforate the prepuce of a penis when phimosis was present.

They can only be treated by removal. When extensive, their excision is the best plan, the operation being performed with the patient anæsthetised, the nitrate of silver or perchloride of iron, or the galvanic cautery being freely applied to the base of the warty growths. In less severe cases, the warts will often wither if kept dry with the oxide of zinc or the fresh powder of savin.

All warts are not, however, gonorrhœal, but may arise without any such cause even in clean subjects. They are, nevertheless, contagious. In women, they are often found up the vagina, but more frequently at its orifice.

Gonorrhœal rheumatism so called, is an undoubted complication of the disease, explain it as we may. At the end of an attack of clap patients without doubt are often attacked with severe pain and tenderness of one or more joints, attended with effusion and constitutional disturbance. It may occur with every fresh attack of clap, and I have recorded a case in my book on the joints, in which it recurred sixteen times after sixteen different attacks of gonorrhœa. Some authors look upon this affection as a species of pyæmia due to the absorption of some morbid matter from the inflamed urethra, but evidence is still wanting to prove the truth of the theory. It rarely appears during the acute stage of the affection, mostly in the chronic, but arrest of the discharge cannot be associated with its appearance. The knees and ankles are the joints mostly involved, yet those of the upper extremities are so at times. The fair-haired and what are called strumous subjects are said to be more prone to the disease, but I cannot say I have observed this.

At times the rheumatic pains are more confined to the tendons and muscles; the heels and soles of the feet are also frequent seats. The late Dr. Babington used to say that this form was found only in those who had taken copaiba.

TREATMENT.—In the acute stage, fomentations locally, with or without poppy-head decoction, or the extract of opium and the internal use of Dover's powder, with alkalies, are the best means to adopt. In the more chronic stage the iodide and bromide of potassium with opium appear to have some influence over the disease. It is, however, at all times obstinate.

Herpes preputialis.—This is a simple affection, which may be mistaken for chancre, and is known by the appearance of a crop of vesicles around the cornea of the glans, or upon the external or internal surface of the prepuce. It is generally attended by much local irritation and local evidence of inflammation, the vesicles when they burst often discharging freely. The affection runs its course in a few days, when the parts heal. A zinc lotion of three or four grains to the ounce expedites recovery, or, a solution of nitrate of silver gr. v to the ounce.

The number of vesicles and their grouping is generally sufficient to enable the surgeon to diagnose this affection from a venereal disease.

CHANCRE

may be defined to be a sore the result of venereal contact, and in a general way, is found upon the penis of the male and genitals of the female, but it may be seen upon other parts of the body, such as the pubes, thighs, lips, tongue, nipples, fingers, &c. &c., in fact wherever the secretion from a syphilitic subject may be applied to a raw surface.

In by far the larger number of cases, this disease begins and ends as a local affection; in a smaller it is a local inoculation of a constitutional disease, and is followed by syphilis. The sore is not syphilis, although it is the direct means of communicating syphilis, no more than the inoculation of smallpox is smallpox, although the inoculation may be the means of giving smallpox.

So long as the disease is local it is comparatively unimportant, however extensive and troublesome it may be in healing. But whenever it is the local inoculation of a constitutional affection such as syphilis, it is of grave importance, however apparently trivial may be the local sore.

It becomes, therefore, a vital question to make out from the local appearances and conditions of the sore, whether it is likely to prove a local disease only, or to be followed by constitutional symptoms, and to a certain extent this diagnosis may be made; that is, a surgeon may from the external appearance of a chancre go so far as to say that in all probability, *this* one will not be followed by syphilis, and *that* one will; but he can do no more, as to dogmatize upon the point and to speak with certainty is beyond his power.

The chancre which will not in all probability be followed by syphilis is the *soft suppurating sore.* The chancre that will in all probability be followed by syphilis is the *hard non-suppurating sore.*

John Hunter thus describes the indurated chancre:—"The sore is somewhat of a circular form, excavated, without granulations, with matter adhering to the surface, and with thickened edge and base. The hardness and thickening are very circumscribed, not diffusing themselves gradually and imperceptibly into the surrounding parts, but terminating abruptly." In this description we read the type of the hard infecting chancre, the chancre of the inoculation of syphilis wherever found. Hunter adds, however, that "a chancre has commonly a thickened base; and, although the common inflammation spreads much further, yet the specific inflammation is confined to this base." An infecting chancre may, too, appear only as a crack, excoriation, or indurated tubercle, without abrasion.

This form of chancre is commonly associated with some induration, not suppuration of the first row of the inguinal glands, the *multiple indolent bubo.* Its secretion consists of epithelial débris, of globules of lymph more or less perfectly formed or disintegrating, and of serum, *not pus,* and not auto-inoculable. In debilitated and unhealthy subjects, adds Lee, infecting sores will suppurate as any non-specific lesion would do, and in such cases it is sometimes very difficult to distinguish the secretion produced by the local disease from that which depends upon constitutional peculiarity.

The *soft suppurating chancre* is often multiple, has an excavated surface with neatly shaped and cut edges as if the wound had been punched out. It has an irregular and worm-eaten surface secreting abundance of pus. It is prone to spread rapidly and to become phagedænic. It has usually a soft base, but if otherwise, it will have what Ricord has described a phlegmonous hardness, and not a defined one, as in the syphilitic chancre. It is commonly associated with a suppurating bubo, and secretes pus, which "has the property of always reproducing its specific action when applied to another part of the same body, or when inoculated upon another person."—*H. Lee.*

The experiments of Fournier, Rollet, and Lee's observations, led the latter surgeon to "conclude that if a venereal sore yields a secretion capable of being inoculated so as to produce the specific pustule, the evidence, so far as it goes, is in favor of its being a local disease, and of its not requiring constitutional treatment. If, on the contrary, a disease which we believe to be primary syphilis yields a secretion which is not auto-inoculable, then the evidence is against the local character of the affection and indicates a constitutional mode of treatment." In this we read the type of the simple local venereal sore.

In a clinical point of view, however, this great distinction between the two forms of chancre is not always definable; and consequently an intermediate class of cases in which syphilis occurs has to be recognized, approaching in their clinical features more the soft sore.

There are, therefore, three forms of syphilitic sore, which the Government Committee on Syphilis has thus well described:—

One characterized by induration throughout its entire course;

One, soft in its early stage, and becoming subsequently indurated; and one soft throughout the whole course, but which, unlike the simple local sore, is followed by constitutional disease.

Hard sores do not of necessity give rise to syphilis, whilst soft sores may. And it is an undoubted fact, that the question of induration or non-induration is greatly determined by the position of the sore; chancres upon the female genitals, simple or syphilitic, and chancres upon the glans penis, being rarely hard.

The point, therefore, resolves itself into this—that the indurated chancre with a fair amount of probability, although not certainty, may be the precursor of syphilis, and not a merely local disease. The soft or non-indurated sore, in exceptional cases, may be due to a syphilitic inoculation, and be followed by the constitutional symptoms, although in the majority of cases, it is a purely local affection.

A crop of soft sores fringing the prepuce, or surrounding the corona, is, in all probability, a simple and non-syphilitic disease.

A spreading chancre with a suppurating bubo, is probably a local affection.

A small single chancre indurated from the beginning, is the most suspicious of syphilis, although even in this, there is no certainty of its being so. In fact, it is not possible to speak with any certainty as to a chancre being syphilitic or otherwise. Syphilis is a constitutional disease which can only be recognized by its constitutional symptoms, and not by the point of its inoculation.

With respect to the *period of incubation* of a simple or syphilitic chancre no definite time can be given, since it varies from a few hours to a week; but the multiple suppurating simple chancres, as a rule, appear more rapidly after the infection than any other, and the syphilitic chancre often does not appear for a week at least, sometimes two or three, after infection. Dr. Bumstead, of New York, says—"that an interval of at least ten days will be found to have existed between infection and the appearance of the sore." (Edition of 'Cullerier's Atlas of Venereal Disease,' 1868.)

A chancre, like any ordinary sore, may present different appearances at different times. It may be at its origin vesicular, papular, pustular, or an excoriation, and pass through the *ulcerating*, *granulating*, and *cicatrizing* stages; in some cases the ulcerating stage will be a long one, while in another it may be so brief as hardly to be recognized.

The action of the sore may vary with the condition of the patient, as well as with the condition of the part upon which it is placed, and it will be influenced probably by the nature or stage of the infecting sore from which the disease has been communicated.

A chancre, like an ordinary sore when there is much local action and little constitutional power, may become irritable, inflamed, or phagedænic, more particularly when drink, irregular living, and debauchery have so enervated the system, as to render the patient unable to withstand the effects of any local irrritation. These various actions may attack the chancre at any period of its progress.

When a chancre is sloughing or phagedænic from the first, and has originated from an inoculation of syphilitic matter, there is every reason to believe that the sloughing process may have a beneficial tendency, since the very intensity of the local effects of the poison may be the means of preventing its absorption, and thus, the outbreak of syphilis. When, however, the sloughing action appears during the ulcerating or latter period of the chancre's progress, it will have no such useful influence; for when syphilis is inoculated through a chancre, it is during its vesicular, papular, or pustular condition, prior to its ulcerative stage, and no action of the sore that appears after this period can have any effect in checking the diffusion of the poison. "If the inflammation spreads fast," writes Hunter, "it shows a constitution more than naturally disposed to inflammation; if the pain is great it shows a great disposition to irritation; it also sometimes happens that they very early begin to form sloughs. When this is the case they have a strong tendency to mortification." "These three conditions of a sore," adds Aston Key, commenting upon the above, "distinct in their cause and in their operation from the syphilitic action, are adverted to, as pointing out the distinction that is to be drawn between the irritable, inflamed, and the sloughing chancre, and afford a guide to the pathological surgeon as safe and intelligible as the more elaborate descriptions of modern writers." ('Guy's Hos. Rep.,' 1840.)

Treatment of Chancre.—The uncertainty that most surgeons entertain as to the nature of a chancre, from the knowledge that any sore upon the penis ranging from a simple excoriation to an indurated chancre may be the inoculation of syphilis, renders it desirable and expedient that all sores should be destroyed at the very earliest period, and when this is effectually done before the ulcerative stage has set in, or during the vesicular, papular, or pustular, there is good reason to believe that syphilis may often be prevented.

When, however, the sore exists as an ulcer, this abortive practice is useless; indeed, in the majority of cases, it makes a small sore large, retards recovery, and in no way prevents syphilitic symptoms appearing where the chancre had had a syphilitic origin. But, taking all together, not one chancre out of four has a syphilitic origin.

For the destruction of a chancre on its first appearance, nitrate of silver, nitric acid, potassa fusa, or chloride of zinc may be employed, the base of the sore being well destroyed.

When this is not done, the chancre should be treated on ordinary principles; to the inflamed, lead lotion, with or without opium, may be applied; to the sloughing, opium with tonics, internally, are indicated; to the indolent, nitric acid lotion or black wash are the best stimulants; while to ordinary sores, water dressing should be used.

A chancre requires no special treatment as a chancre, beyond its primary destruction from motives of expediency, or from reasons of weight to destroy a supposed syphilitic inoculation. The common practice of applying black wash to all sores on the penis is not needed; and to cauterize all chancres at every stage of their existence as soon as they come under notice is unnecessary. But when the powers of the patient are feeble, tonics are called for, and any special conditions are to be treated as common sense indicates.

Medicines useful for syphilis should only be given when other evidence of syphilis exists beyond that afforded by the local inoculation. To treat all chancres alike, as if due to syphilis, is uncalled for and unscientific; by doing so many patients are sacrificed to a theory greatly to their detriment.

COMPLICATIONS OF CHANCRE.

Phimosis is one of the most common, and is found in at least a fourth of all forms of chancre and at all stages of their progress, although with the sloughing sore, it is probably the most frequent. In the fringing preputial chancres, however, it is a common complication. It is an accidental accompaniment of a chancre, and is due to the inflammatory infiltration of the prepuce. When not severe, it is not a condition of much importance, if local cleanliness be attended to, for as the chancres heal, the inflammatory œdema will subside and the parts assume their natural condition.

When, however, *œdema is present*, and a blood-stained discharge mixed with the débris of broken-up tissues escapes from beneath the prepuce, and doubt consequently is felt as to the nature, position, and character of the chancre; when evidence exists that the parts beneath are undergoing a destructive process which demands direct local treatment, the prepuce must be slit up, the surgeon taking care to do this effectually; since through a want of due attention to this point, the glans penis may be destroyed or the prepuce perforated. When the sore has been exposed, it ought to treated on ordinary principles. When a simple purulent discharge comes from the orifice of the prepuce, the constant use of water and simple lead or other injection will probably suffice. Phimosis without inflammatory œdema rarely calls for treatment.

PHAGEDÆNA.

Venereal like other sores may slough, the suppurating chancre becoming more prone to take on this action than the non-suppurating and indurated. When a sore sloughs from the first, it will probably prove to be non-infecting, and even if syphilitic in its origin, it may lose its syphilitic nature, the sore, when the sloughing action has ceased, becoming a simple one. This action is at times so intense that the penis rapidly swells, inflames, and becomes gangrenous after infection, the whole organ at times sloughing off; while, at others, the action will be more partial.

In exceptional instances, the mortification is of the dry kind. In the Peninsular War, when the British troops were in Portugal, the sloughing of the penis from inflammation was so severe that Inspector Fergusson ('Med.-Chir. Trans.' vol. iv) wrote: "It is probable more men have sustained the most melancholy of all mutilations during the four years at war in Portugal through this disease, which was called the 'black lion,' than the registers of all the hospitals in England could produce in the last century." He attributed the severity of this affection to the free sexual intercourse of persons of different nations.

How far this phagedæna depends upon some peculiar power of the infecting poison, or upon the constitution of the individual patient, is difficult to determine, although the latter probably has the greater influence, since, when any such depressing agency as that caused by drink, excess of venery, or illness is present, phagedæna is more likely to occur than under other circumstances.

TREATMENT.—In the treatment of all cases of phagedæna, opium, tonics, and good living are the three essentials; while mercury and the iodide of potassium are inadmissible.

Locally, the part must be kept clean by frequent ablution, and to this end, the prepuce often requires to be slit up. Lotions of nitric acid, one drachm to five ounces of water; of carbolic acid, one part to thirty; of sulphate of copper, five or ten grains to the ounce; of potassio-tartrate of iron, from ten to twenty grains to the ounce are also useful, and opium in solution is often a good addition. When the disease spreads, local mercurial fumigation is said to be of value; but change of air is most beneficial.

Adenopathy or bubo is a common complication of the simple as well as of the infecting chancre; that is, it is found in the local venereal sore as well as in the inoculation of true syphilis, but in the former the gland as a rule suppurates, while in the latter it rarely does so, at any rate as a consequence of the local sore.

"Lymphatic absorption," writes Lee, "from a suppurating syphilitic sore (simple) necessarily produces a suppurating bubo; any attempt to prevent such an affection from suppurating is entirely futile. The disease within the lymphatic system is the same, and runs a similar course as that upon the surface of the body."

The bubo associated with the simple non-infecting sore is the direct result of the absorption of the specific pus, the matter in the interior of the gland retaining its specific characters, whilst that outside the gland is ordinary non-specific pus. As the disease advances, however, the two fluids mix, and the whole acquires the characters of the specific fluid, the surface of the sore about the glands becoming in this way inoculated.

In the infecting and syphilitic chancre, the enlargement of the gland is usually indolent, and unconnected with suppuration. It appears within the first or second week of the inoculation, and many glands are usually involved, forming hard, indolent, painless swellings. In exceptional cases, however, where the sore is a source of local irritation, suppuration of the glands may take place—the suppurating bubo in the course of the constitutional symptoms being no rare event. The presence or absence of suppuration in the inguinal glands is not therefore evidence of any positive value as to the existence or non-existence of a syphilitic affection. It may, however, be stated that a local sore on the penis associated with an adenopathy, which passes rapidly on to suppuration, is in all probability a local and not a syphilitic affection, while a local sore with a simple induration of the glands is in all probability a syphilitic inoculation.

In every form, therefore, of chancre, though more frequently in the local sore, simple adenitis or sympathetic bubo may be met with as a result of local irritation, which differs in no respect from the adenitis of any other local organ. One or more glands may be involved in the action, and suppuration may be acute, subacute, or chronic. In the simple local sore it is usually acute. As a rule, too, the sore formed by the venereal bubo, unlike that resulting from simple adenitis, instead of healing kindly, often takes on very much the appearance of the local disease; the edges ulcerate, the opening enlarges, and a large sore is formed; indeed, from this action, the *serpiginous* sore, to which allusion will be made, often takes its origin. At times the bubo puts on a phagedænic action and spreads fearfully.

In rare cases, the glands are said to enlarge without any local lesion, this chronic enlargement being followed by syphilis. I have, however, never seen a marked instance of this, and in reputed cases, have suspected the former existence of some overlooked local sore or fissure. Mr. Cock does not recognize the affection.

TREATMENT.—There is nothing to be gained by suppuration of the inguinal glands, for even when associated with syphilis, the poison is not eliminated by such means, and when due to some simple local source of irritation is only an additional cause or annoyance.

To endeavor to prevent suppuration is, consequently, a wise course, which can best be done by rest and the local application of cold in the form of ice in a bag, or lotions of lead, muriate of ammonia, or spirit. When suppuration is threatening or cannot be retarded, warm fomentations are the best, and as soon as pus has formed a free incision should be made, followed by warm-water dressing or a poultice. A vertical incision, as a rule, is the best, but when the abscess is large the opening should be made in the long axis. The application of leeches or iodine to a bubo that threatens to suppurate seems a useless practice.

In the indolent bubo, or rather where indurated glands exist, local treatment is useless though care should be observed that no local source of irritation is added to that of the sore, and no excess of exercise taken by which the inflammation may be increased.

When the cellular tissue around the glands is infiltrated with inflammatory products as indicated by its brawniness, &c., the value of local pressure by means of a pad and the spica bandage (Fig. 278) is unquestioned; while tonics, rest, and other constitutional treatment are beneficial. The local application of some mercurial ointment at times appears to be of use, and a small blister, a strong solution of iodine or of nitrate of silver, is of value in hastening either the absorption of the inflammatory products or their suppuration. As soon as suppuration appears, the abscess should be opened. When a hard gland is left at the bottom of a suppurating wound, the American practice of applying such a caustic as the potassa fusa to its centre, to cause its death and subsequent sloughing, or Golding-Bird's electrolytic caustic, occasionally is of great use, this practice being as useful in syphilitic glandular enlargements as in others. In some instances, the removal of the gland by the scalpel may be expedient. Sinuses must, if possible, always be laid open.

If phagedæna attacks a bubo, the local application of nitric acid, or the actual or galvanic cautery is sometimes called for, more particularly when, in spite of general or other local treatment, it spreads. Opium, tonics, and other internal remedies must not be omitted.

HYDROCELE OF THE CORD AND OF THE TESTICLE.

Hydrocele or a collection of serous fluid in close connection with the testicle or spermatic cord, is a term which has been applied to two classes of cases which differ in their progress as well as in their pathology, and agree only in the one marked and prominent symptom to which the term hydrocele is applicable. For clinical purposes, however, the word has certain advantages, and, with this view, may still be employed.

Accepting the term, therefore, as signifying a collection of fluid in close contact with the testicle or spermatic cord, two great divisions of the subject at once suggest themselves, namely, the *vaginal hydrocele* or the collection of fluid into some portion of the tunica vaginalis either of the cord or testicle, and the *encysted hydrocele* which is an expanded and newly formed cyst, as a rule, in connection with the epididymis, and but rarely with the body of the testis.

On the formation of the serous sac.—It is well known to all who have studied physiology that the testicle in its descent from the loin during fœtal life draws with it into the scrotum two layers of peritoneum with its attendant nerves and vessels, and that all pass through the internal and external abdominal rings in front of the cord into the scrotum. The posterior layer of peritoneum being in close connection with the fibrous capsule of the body of the testicle—the tunica albuginea—and the anterior in connection with the purse or scrotum. In a perfectly normal condition, it is generally supposed that at birth or shortly after, the two surfaces of this serous membrane close and become adherent, the canal which was at one time present ceasing to exist from the internal abdominal ring to the upper portion of the testicle; while in the scrotum, the two serous surfaces remain permanently free for the purpose of allowing easy and ready mobility of the testicle in its scrotal covering. Mr. Birkett, however, has demonstrated that the prolongation of the serous membrane down the inguinal canal into the scrotal sac often remains patent for a longer period than has generally been supposed, indeed in some cases it continues more or less as a pervious canal during the whole of life. It is owing to this fact that in a large proportion of the examples of oblique inguinal hernia, the bowel descends into the open vaginal process of the peritoneum which passes down with the testicle.

In connection with this subject, the following anatomical facts may with some confidence be accepted:—

That the opening into the peritoneal cavity at the internal ring is frequently open at birth and during the whole of adult life.

That the vaginal process of the peritoneum may remain as a more or less open canal during childhood, and even up to old age; and that this tube may extend partially or wholly through the inguinal canal, and even into the scrotal vaginal sac.

That this naturally formed peritoneal tube and sac may be closed at the internal or external abdominal rings, or at any intermediate spot between these points, or at its junction with the testis.

As a consequence from these facts it is tolerably clear that a collection of serous fluid may take place in any part of this prolonged serous channel, and that a hydrocele of the cord or testis of different kinds may be produced.

We thus find during infant and early life, from a want of closure of this tube at the internal ring or at some lower part of its course, that a serous exudation may take place into the cord or the scrotal portion of this peritoneal sac, and, that under the former circumstances a *congenital hydrocele of the cord*, and under the latter, *congenital hydrocele of the testicle* is said to exist. When the tubular portion of the canal is closed above, and the testicular part is open, a *simple vaginal hydrocele* exists; and, when the tubular portion of the canal is not closed below, the hydrocele may extend more or less up the canal even as far as the internal ring.

In another class of cases, the serous fluid may be confined between the internal and external rings, giving rise to the so-called *diffused hydrocele of the cord;* and, when it occupies a still more restricted space, it is usually described as an *encysted hydrocele of the same part.*

The pathology of all these different conditions remains, too, the same, the different position of the fluid being accidentally determined by the extent and lines of adhesion, or the closure of the peritoneal testicular prolongations. A reference to Figs. 261–2–3, given to illustrate the subject of hernia, p. 458, will assist the student in understanding these points.

The Pathology of Hydrocele.

It may with considerable confidence be asserted that, as a general rule, the secretion of the serous fluid which gives rise to the ordinary vaginal hydrocele is due to an inflammatory vaginalis; because in certain cases, flocculi of pure lymph may be seen floating in the secretion, while in others spontaneous coagulation of the same may be observed. The thickening of the tunica vaginalis, moreover, which so frequently takes place in chronic cases, the presence of membranous bands and septa in the cavity of the serous sac, and the fact that this form of hydrocele may be produced by extension of the inflammatory action from the epididymis or the body of the testicle, point likewise to the same conclusion.

It is not, however, so clear that an inflammatory action has any influence in the production of the serous effusion in the congenital form of hydrocele, in which a communication still exists between the abdominal peritoneal cavity and the scrotal serous sac; indeed, it would rather appear as if the exudation was of a passive nature and merely an excess of the natural secretion of the serous membrane, since in many of these cases the fluid rapidly disappears under tonic treatment, being re-absorbed as the powers of the patient improve, and *vice versa.*

The fluid of a vaginal hydrocele is invariably albuminous, as the secretion of all serous membranes contains albumen in solution, and under the influence of an inflammatory action, this is markedly increased; hence, the amount of albumen in the fluid of a hydrocele is determined by the nature and violence of the inflammatory action. In some cases of the vaginal, as of the congenital variety, we thus find it as a thin, serous, and saline fluid of a clear color, slightly tenacious and albuminous, the fluid differing in no single point from the natural serous fluid of the peritoneal cavity, while in others, it is of a more tenacious character, varying from a pale amber to a deep straw color. In some examples, the fluid will be stained with blood, in others it will hold cholesterine in suspension, at times being perfectly opaque and syrupy from the presence of such matters. It is, however, in the old and chronic cases alone that these last conditions are to be observed.

In the *acute vaginal hydrocele*, more or less fibrin will be found either in solution, or in the form of false membrane or adhesions between the two surfaces of the serous membrane; and, in *the chronic*, the walls of the cyst will be found to have undergone great changes; the thin clear membrane having become thick and opaque, owing to the organization of the inflammatory product which had been poured out into its tissue, and in certain cases containing cartilaginous or ossific deposits, while on its surface, it will present a firm fibrous appearance. In rare cases, suppuration has been observed to occur in the tunica vaginalis, but this result is beyond my experience, except as the effect of some external irritation or plan of treatment which had been adopted for its cure.

Uncomplicated hydrocele, or a simple effusion into the tunica vaginalis, unassociated with any disease of the testis or epididymis, is generally a painless and insidious affection; it attracts attention mainly by its size, and demands treatment chiefly from the mechanical inconvenience it causes. It is generally of slow progress, and, as a rule, will be found to have existed for many months before seen by the surgeon, the patient seeking advice only when the organ has become cumbersome, and from its weight, has excited some pain and dragging in the lumbar region.

The Clinical Examination of a Hydrocele of Testicle.

On examining a testicle the seat of this disease, the enlargement will be found free and really movable, and to occupy the position of that organ which it includes. On inquiring into the history of the case, it will be ascertained that the swelling appeared primarily in connection with the testis, and gradually encroached upon the upper portion of the scrotum towards the external ring, while on careful examination, the cord will generally be felt clear and distinct above the tumor. In exceptional cases, however, the fluid will be found to pass upwards through the external as far as the internal ring, it being tolerably clear in such examples that the peritoneal testicular process has closed only at one point, and that is at its internal abdominal opening (Fig. 261). On taking the tumor in the hand it will be found to be light, and on passing the fingers over its surface it will be felt smooth and uniform. Fluctuation will also readily be detected on the slightest and most delicate palpation. The position of the testicle should then be looked for and made out; its natural site being somewhat posterior, and in large tumors, towards the upper part. But it must be borne in mind that in certain examples, that is, in cases in which the organ is malplaced, the testicle may be in front of or below the tumor. The best test of its presence is afforded by manipulation; the peculiar testicular pain felt on the application of pressure affording a certain indication. The question of translucency should next demand attention, for when present it is of peculiar importance, and indicative of the vaginal hydrocele. It must be remembered, however, that such a symptom is not constant, since it is neither present in cases of hydrocele in which the fluid is thick, bloody, or opaque, nor when the walls of the vaginal tumor have become thickened by fibrinous deposit.

It should be added, that for this translucency to be well observed, the integuments of the scrotum should be firmly stretched over the scrotal enlargement.

The tumor is generally described as being of a regular and pyriform shape, but this condition is very variable, since the shape of the swelling depends upon the openness of the tubular peritoneal membrane of the cord and the connection which exists between the surfaces of the tunica vaginalis testis and tunica vaginalis scroti. When the canal has closed and withered down to the body of the testis, the swelling will be more or less globular; and the higher the point of closure of the vaginal peritoneal sac towards the internal ring, the more pyramidal will the watery swelling necessarily become. If adhesions exist between the two layers of serous membrane at the lower portion of the testis, the hydrocele will appear to be at the upper part; and, when the natural contraction between the tunica vaginalis of the cord and of the testicle is not completed (Fig. 263), an irregular or even hour-glass contraction may make its appearance—the outline of a hydrocele depending much upon the anatomical conditions of the part in which it is situated, and the pathological changes which may have resulted from the affection. The true pyriform swelling is best seen in children, when the fluid will be found frequently to pass well up the cord, although in adults it is not uncommon.

Hydrocele occurs at all ages, but it is somewhat common at birth and middle age, and in a large proportion of cases appears as a one-sided affection, and seems to affect the right or left testis indiscriminately. Curling informs us that of 115 cases, 65 occurred on the right, 44 on the left side, and 6 were double; while out of 117, my own cases, consecutively observed in which these facts were noted, 41 occurred on the right side, 62 on the left, and 14 were double, results coinciding with the opinions of Velpeau, Gerdy, and others.

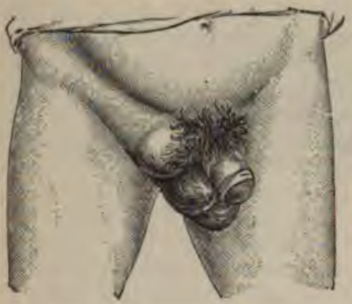
By way of summary it may be said, a chronic vaginal hydrocele appears as a painless enlargement of the testicle, of slow and unequal growth, and of variable size, with a smooth and uniform surface, and more or less tense and fluctuating feel. It is invariably movable within the scrotum, and, as a rule, appears to be distinct from any abdominal connections. The presence of the testis within the swelling can generally be made out by the testicular pain, which is produced by pressure at its posterior and upper portion, if the tumor be large, and at its lower if small; or by the absence of translucency at one spot—the tumor, as a rule, transmitting light when its scrotal coverings have been well stretched. It has a tendency to remain tranquil for many years, and by age simply increases in size. It occasionally grows to enormous dimensions, when the penis may become buried within the swelling; but never proves dangerous to life. It causes pain and requires treatment mainly from mechanical causes.

Hydrocele of the cord.—It has been already briefly explained how a hydrocele of the cord may be produced, and under what circumstances it may appear as a *diffused* or a so-called *encysted* tumor. It has likewise been shown, how these two conditions are but modifications of the same disease, the diffuseness or isolation of the affections being determined by the adhesion, or more or less complete closure of the vaginal process of peritoneum as it passes downwards into the scrotum. Thus, a *congenital hydrocele* of the cord will be present, when, from a want of closure at the abdominal orifice of the vaginal peritoneal process, serous fluid can gravitate downwards as far as the external ring, where the canal is obliterated; and a *diffused hydrocele* of the cord will be said to exist when, either at an early or late period of life, serous fluid collects in the vaginal process closed at the internal ring and between it and the external ring or upper portion of the testis; while in a third class of cases an *encysted hydrocele* of the cord may appear as a small isolated bag of serous fluid movable with the cord and connected with it, situated between any of these points, its circumscribed nature having been determined by a more complete closure of the vaginal peritoneal process, and the limited space into which the effusion has taken place.

Under all these conditions, however, the pathology of the affection is the same, and the symptoms indicating its presence vary only according to the size and tension of the sac which contains the fluid. In the congenital form in which a communication exists with the peritoneal cavity, the hydrocele will fluctuate and have a smooth and uniform outline, but it can never be tense. It will also disappear more or less readily by pressure, or by elevating the testicle on the patient assuming the recumbent position, when the fluid will gravitate into the abdominal cavity, with a rapidity which varies according to the size of the peritoneal communication.

In the diffused hydrocele of the card, this disappearance of the swelling by rest or pressure will not take place, for in such, the opening of the vaginal process will have closed naturally. The tumor will thus appear as a baggy or tense elastic swelling in the inguinal canal, which it will more or less fill. It will give to the hand a sensation of fluctuation, and, in certain instances, may appear translucent. It will, moreover, on any traction of the testicle, be found movable, and painful in proportion to the amount of tension of the cyst or of the inflammatory action.

FIG. 377.



Encysted hydrocele of the cord.

In the more localized or apparently cystic hydrocele of the cord, the same symptoms will present themselves. The tumor will be more isolated, probably more movable and more tense, and it will be readily acted on also by any traction on the testis. It may occur as a single cyst or as many cysts, but each will present the same symptoms. When a single, tense, movable cyst exists, it may be mistaken for a distinct morbid growth; but the diagnosis of the case ought not to be difficult when care is observed. Fig. 377 well illustrates the ordinary appearance of the affection.

TREATMENT OF THE VAGINAL HYDROCELE OF THE TESTIS.—In the *congenital hydrocele* of young life, surgical treatment should be very simple, for the disease as a rule readily disappears with age and increasing strength. A little cold lotion applied to the part, such as a solution of the hydrochlorate of ammonia and tonic medicine, is frequently sufficient to effect a cure; for, as I have already stated, the effusion into the vaginal sac in these instances seems to be often of a passive nature. The hydrocele found in infancy is not, however, always of the congenital form; as a hydrocele may exist in an infant in which there is no communication with the peritoneal abdominal cavity through the neck of the vaginal process, and, under these circumstances, a different treatment may be required. Cold lotions and tonics may be of use, and certainly should be primarily employed; yet in many instances, the treatment will fail to cure the case. *Acupuncture* may be then employed, and the fluid allowed to escape into the cellular tissue around the sac, when it may be altogether removed by absorption; but this treatment is not as a rule satisfactory, it being exceptional for a permanent recovery to be secured by such means, and I am disposed to think it better practice to draw off the fluid by means of a fine trocar and canula, and to excite some fresh action in the membrane lining the tunica vaginalis by stirring it up with the end of the canula. This practice has been very successful in my experience.

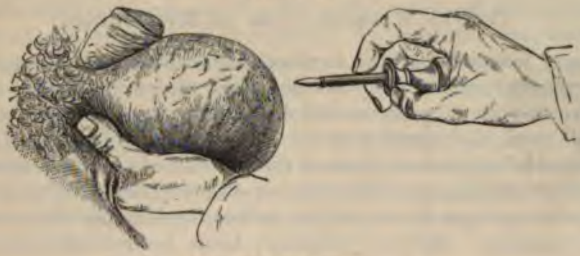
The treatment of vaginal hydrocele in the adult.

In early examples, when the hydrocele is still small, and consequently of little inconvenience, it is well, perhaps, to leave it alone, for unless it causes anxiety to the patient, or proves troublesome or inconvenient from its size, there is no necessity for interference. *In very old people* it is as well not to interfere, unless a strong necessity exists, as sloughing of the scrotum, suppuration of the sac, and other bad results, occasionally occur in these cases from slight causes. It must be added, that the feelings of the patient as to the amount of pain and inconvenience are the best guide to interference, very slight enlargement causing as much pain in some patients as a greater increase in others. If, then, some treatment be demanded, simple tapping should be performed as a primary measure, the fluid being drawn off by means of a moderate-sized trocar and canula. In doing this, some care is necessary, although the operation is really simple, as difficulties are often made by the operator, while dangers result from want of caution.

ON THE TAPPING OF A HYDROCELE.

As a point of primary importance, the true position of the testicle should be defined. In the majority of cases it will be found at the posterior part of the tumor and towards its lower part, unless the hydrocele be very large. At times, however, as has been observed, it will be found in front from a congenital malposition, as well as in certain other cases which are difficult to explain. The true position of the gland can generally be made out by manipulation, and further by want of translucency in the tumor at the part it occupies. Having made out to a fair certainty the position of the testis, the tumor should be taken in the left hand and grasped firmly at its neck—the surgeon taking care at the same time to stretch the integument well over the cyst, and to render its wall tense and unyielding (Fig. 378). The trocar with well-fitting canula (having been previously well oiled) should then be taken in the right hand, and the index-finger placed about three-quarters of an inch from the extremity of the canula, while the front of the thumb rests on its flange.

Fig. 378.



Tapping a hydrocele.

The object of this position of the finger is to prevent the instrument going in too far with a rush, and thereby endangering the testicle; and that of the thumb to press home the canula as the trocar is being withdrawn. The tumor should be punctured at its lower part, care being taken to avoid any large vein, and the fluid allowed to run out. Having completely emptied the cyst, the punctured integument should be firmly held and nipped up with the thumb and finger of the left hand, and the canula withdrawn, a little cold air or the irritation of the finger generally causing sufficient contraction of the dartos to close the wound and preventing hemorrhage or any further escape of the remaining fluid. A piece of lint, however, may be applied over the puncture for the purpose of cleanliness and to prevent friction.

In certain examples of this disease in the adult, I have been induced to stir up the cyst as I have described in the hydrocele of the young, and have met with some success. In no instance has any evil consequence resulted from the practice, and in several, a cure has taken place, evidently from inflammation. I would advise this practice to be confined, however, to young adults. As a palliative practice it is scarcely necessary to recommend any other than that described, as it is simple, more efficacious than any other, and not more dangerous. Acupuncture has been advised, but it has no practical advantage over the simple tapping, and it is certainly less successful in its result. In exceptional cases it may be good, particularly in such a case as Mr. Curling has described on the authority of Mr. Luke, of a gentleman who was about to proceed to a part of the world where surgical advice could not be secured, and where the patient could then perform this simple operation on himself. I have even known a patient to tap himself.

The period of relief which a patient experiences from a simple tapping varies exceedingly from a few weeks to many years; and even in the same patient the interval will be found to vary from time to time. In the young and middle-aged adult, when the general health is sound and a return of the effusion has taken place, unless any personal objection should be made, it is generally advisable to adopt some plan for a more permanent cure. In old men it is the soundest practice to rest satisfied with the palliative treatment; and in such the radical cure should be proposed only in exceptional cases.

Treatment of hydrocele of the cord.—The principles of treatment which have been laid down in cases of hydrocele of the testis are likewise applicable to those of hydrocele of the cord, their application requiring only such modifications as may be demanded by the altered position of the affection. In the *congenital* hydrocele, no special treatment is required, because, as strength comes to the child, the fluid probably will be reabsorbed, and failing this result, tonics should be given to expedite the cure, and cold lotion applied such as the chloride of ammonium with vinegar, ʒj to Oj.

In the *diffused or encysted* hydrocele of the child or adult, more active treatment is frequently demanded, though not in all cases; the fluid will at times disappear without treatment, though it may recur at a later date; still the affection ceases to trouble, and, unless some real inconvenience is produced by its presence, it is as well to leave things alone. When, however, pain or inconvenience is experienced, something must be done, and no doubt the best practice is to evacuate the fluid. In small, tense, encysted hydroceles, the practice of evacuating the fluid by acupuncture is certainly sound, since tapping by the trocar and canula is an operation of some difficulty where the cyst is small. It may be done with any needle, but those employed for cataract are probably the best, and several openings should be made. Tapping may be employed as in any other case of ordinary hydrocele. I have used on several occasions with success the radical cure by injection, and have not met with any bad results. When this treatment fails and further measures are demanded, as a last resource an incision into the cyst may be made.

ON THE RADICAL CURE OF HYDROCELE.

It is not necessary to review all the various plans which have been and are now employed for the permanent cure of a hydrocele of the tunica vaginalis. It will be more to the purpose to give the line of practice which is most successful and which at the same time is very simple, viz., the injection of the cyst with a solution of iodine. It is perhaps not a question of much importance whether the fluid should be concentrated or diluted, or whether it should be permanently left in the cyst or withdrawn after a few minutes have been allowed for it to act upon the secreting surface, such minor differences may be left to the fancy of the operator. My own judgment leans towards the practice of injecting a mixture of a drachm or more of the compound tincture of iodine with double the quantity of water, and allowing it to remain, care being taken that the canula is previously well pushed home into the cyst, and that no iodine solution is allowed to escape into the cellular tissue outside the sac. By this practice, a radical cure is almost certain to be secured, and only exceptionally does any failure or evil result follow. If the latter occur, it is generally due to the fact, that a hydrocele has been injected when some inflammation of the testicle coexists, and from which it has been produced. In all examples of hydro-testitis, the practice of injection must be looked upon as injurious, and is treating the result of a disease, and not the disease itself, the effect, and not the cause. I do not propose to enlarge upon the other forms of treatment which have been employed, such as incision, caustic, or even setons; since the practice I have advocated is so simple and successful as to surpass all others. Within the last two years where the iodine has failed I have used warm water as an injection. It answered well, but set up more inflammatory action than the iodine, indeed, in several cases, it excited suppuration. Some of the Dublin surgeons speak highly of the practice of introducing into the sac of the tunica vaginalis a grain or more of the biniodide of mercury made into a paste with some grease, and I have followed this practice in some cases with advantage. I prefer, however, the iodine treatment.

ON ENCYSTED HYDROCELE OF THE TESTIS.

On examining the testis of the adult after death, it is by no means an uncommon occurrence to meet with small cysts connected with the epididymis. These may be single or multiple, and, in many instances, are very numerous. They are generally more or less pedunculated, and as a rule, are connected with the upper portion of the epididymis, and filled with a clear watery fluid which contains in certain cases some granules.

The pathology of the formation of these cysts is somewhat difficult to understand, and, surgically, is of small importance, since they seldom, if ever, become of sufficient size to cause inconvenience, or to require any operative interference; indeed, they are rarely diagnosed during life, and are only discovered on post-mortem dissection.

Another kind of cyst is occasionally met with connected with the testis, and in close contact, if not associated, with the epididymis. It has been described as the encysted hydrocele. It springs from the same part as the smaller cyst, but grows to much larger dimensions, and generally contains a very different kind of fluid. Its origin is as obscure as the former. It enlarges very slowly, does not give rise to any pain, nor produces any inconvenience other than that caused by its size. It seldom requires treatment in its early stage, and, as a rule, many years are allowed to pass before interference is demanded, the tumors frequently developing for twenty years or more before advice is sought. These cases are by no means so common as the ordinary vaginal hydrocele—not more than 5 per cent. of the cases of hydrocele being of this kind.

A cyst is occasionally developed between the tunica albuginea of the testis and the tunica vaginalis testis, the pathology of which being very obscure. Mr. S. Osborne suggests, and I think with good reason, that this is merely an enlargement of the corpus or hydatid of Morgagni—a constant structure, existing as a pedunculated vesicle situated between the summit of the globus major and the body of the testicle, between the visceral layer of the tunica vaginalis and the tunica albuginea ('St. Thomas's Hospital Reports,' 1874). Cases of this kind are described by Curling and Hutchinson. Guy's Museum contains a specimen. I know of no means of diagnosing their existence. Their treatment would be similar to that of other cysts.

Symptoms and diagnosis.—In an early stage of encysted hydrocele the diagnosis is not difficult, as the cyst usually appears as a kind of budding of the testis or rather of the upper portion of the epididymis, as a tense, hard, globular, and, in some cases, pendent tumor, more or less intimately connected with some portion of the spermatic duct. It is generally discovered on the part of the patient by accident, and, when as large as the natural testicle, has been set down occasionally as an extra organ.

The surgeon is not often consulted in such a case in its early stage; the tumor having been allowed to grow to an inconvenient size before advice is sought. In forming a diagnosis, the history of the case will often at once throw some light upon its nature; and the surgeon, in all probability, will discover that its increase has been extremely slow, twenty years or more often intervening before the cyst attains anything like a large size; these encysted hydroceles probably never growing so fast nor acquiring such dimensions as the more common vaginal species.

The next feature demanding attention in the development of these cysts is their shape and outline, which are often rather striking. They never in their early stage, and rarely at any time assume the appearance of ordinary vaginal hydrocele, and almost always maintain a globular outline.

The position of the testis in its relation to the cyst next claims attention, and a marked difference exists between the encysted and the vaginal hydrocele. In the latter, as a rule, it is to be found at the posterior part of the sac—when the tumor is small towards its lower, when large towards its upper part. In the former, or encysted, it is to be found in front, at one side, or below, and rarely at the posterior part. The reason for this is easily explained. The cyst is usually connected with the epididymis which normally lies at the posterior part of the gland.

The nature of the cystic contents differs also in many points from the fluid of a vaginal hydrocele, and is very characteristic. In the *vaginal* hydrocele the fluid has been described as being generally clear, like the serum of the blood, more or less albuminous, of a straw color, and, at times, spontaneously coagulable, blood and cholesterin being also occasional elements. In the fluid of an *encysted* hydrocele, none of these elements are generally present; but, as a rule, is a limpid, slightly saline liquid, more or less watery or opalescent, as if mixed with milk, always containing some granules in suspension, and frequently spermatozoa. Cystic hydrocele differs from the vaginal in the slowness of its growth, its globular outline, the anterior position of the testicle, and the nature of its cystic contents.

The origin of the spermatozoa in these cysts is a point of peculiar interest, and has been a disputed point with pathologists for many years. Mr. Curling's investigations on this subject have proved, that in some instances, their presence is certainly due to the rupture of one of the spermatic tubes which pass over and are in close connection with the walls of the cyst—this rupture taking place generally from an injury, and being indicated by some rapid increase in the size of the cyst. Mr. Curling has shown that this history was given in several of the cases in which spermatozoa were found, and in some he was even able to demonstrate a distinct communication between the cyst and the spermatic tube. The following case tends to support his views. Robert P——, æt. 60, came under my care, at Guy's Hospital, on December 28th, 1863, with an encysted hydrocele of the left testicle of twenty years' growth. The increase had been very slow until the last month, when the tumor had doubled its normal size, this rapid growth having followed an injury produced by a fall. When first under my observation, the scrotum contained an irregular cystic tumor on its left side, evidently made up of several cysts, of which three of large size could readily be distinguished, two being very tense, while the third was baggy. The testis was found on the inner side of the tumor. Tapping was at once resorted to, and the largest cyst emptied, many ounces of a milky fluid being drawn off. The second tense cyst was then tapped through the same opening, with a similar result, and the fluid collected in a distinct glass. The third cyst was also tapped, but in this the fluid was quite watery. The first two contained an abundance of spermatozoa, while the third did not contain any. A good recovery took place.

The treatment of encysted hydrocele.—However iteresting the two forms of hydrocele which we have just been considering may be, both in their pathology and in their points of difference, the treatment in the two cases is practically alike. When anything is required to be done, simple tapping may suffice, and, as a primary measure, it should always be preferred; but, should the radical cure be required, the injection of iodine may be carried out. The slow growth of these cysts, however, and the equally slow re-collection of their contents, after tapping, are points which indicate the propriety of adopting the palliative treatment in the majority of cases.

On the spontaneous disappearance of a vaginal hydrocele, with a case.—It is well known that in children, hydroceles, as a rule, disappear spontaneously with little or no treatment, but in adults such a result is most uncommon. Messrs. Pott, Curling, and Sir B. Brodie relate cases of this kind, and attempt to explain the process by which such a recovery takes place with more or less success. A single instance of the kind has passed under my hands for treatment.

Charles C——, æt. 64, came to Guy's Hospital on Jan. 29th, 1863, with a hydrocele of the left testis, the size of a cocoa-nut. It had been of two years' standing, and been tapped six times, having been under my care on each occasion. He came under my notice at this date, when I was about to leave the hospital, and I did no more than examine the parts which were tense and painful, telling the patient to return to me in the course of a few days to be relieved. When he came the following week, all indication of swelling had completely disappeared, the man assuring me that he had gone to bed the night of the second day before his visit with a large tumor, and that when he awoke it had disappeared. He added also that on the following morning he had passed a large quantity of thin urine. The patient was a steady man and a widower, and told his tale with all the appearance of truth and with some astonishment. In three months the fluid had re-collected, when he was tapped. I will not attempt an explanation of this case.

HÆMATOCELE.

As the term "hydrocele" is applied to the effusion of serous fluid into the sac of the tunica vaginalis and of its tubular prolongation upwards to the internal ring, as well as into the cysts which have been already described as being connected with the testis, so the term "hæmatocele" is employed to designate an effusion of blood into the same parts. We thus have—

A *vaginal* and an *encysted* hæmatocele of the *testis.*

A *diffused* and an *encysted* hæmatocele of the *cord.*

Hæmatocele may occur in an organ which had not previously shown any symptom of disease, or, it may be, associated with a hydrocele. It may appear spontaneously without an injury, or as the result of a blow, strain, or the tapping of a hydrocele. It may attack patients at any period of life, and in certain rare cases at a very early age, even in infancy. I have the records of a case in which it was said to have made its appearance at two years of age.

In the notes of my cases various causes have been assigned for its production. In more than one instance "it appeared gradually without any known cause." In another "it occurred when hard at work pushing a wheelbarrow, something giving way with a snap." In the majority it came on as an immediate consequence of a blow, and in several as the result of the tapping of a hydrocele, In all; however, the result was the same—a more or less rapid formation of a tumor in the position or neighborhood of the testicle.

Symptoms and diagnosis.—The symptoms of a hæmatocele which has made its appearance without any injury or assigned cause are very obscure, and are pretty well summed up in the prominent one of a gradual and uniform enlargement of the organ. The swelling will vary in shape as in a hydrocele, but, like it also, may present a more or less pyriform outline. The testicle will always, in the vaginal hæmatocele (on careful manipulation being made), be detected somewhere in the sac, and usually at its posterior and lower part, the peculiar testicular sensation being produced by slight pressure.

When caused by a sudden strain or injury, the enlargement will be more sudden as well as rapid, and be found to follow close upon the receipt of the accident, while the rupture of the bloodvessel may be announced by the sensation of a sudden snap or giving way.

The local symptoms are similar to those already described.

The tumor, on its first appearance, may be somewhat soft and obscure, or clear fluctuation may be detected in it; but if much time be allowed to pass before coming under observation, this fluctuation will not, in all probability be made out, for the effused blood rapidly coagulates, and gives rise to the sensation of a solid growth. The sac of the hæmatocele, whether tunica vaginalis or cyst, rapidly alters in character and becomes thick, and in certain cases fibrinous, or even cartilaginous; at first from the coagulation of the fibrine of the blood upon its inner surface, and, in cases of longer standing, from distinct inflammatory changes brought about by the presence of the blood acting as foreign matter. In some instances this thickening of the cyst is very great, even to the extent of half an inch.

When a hæmatocele has followed upon a hydrocele, there will usually be a sudden enlargement of the part after the strain or injury, accompanied with more or less pain, this pain apparently depending upon the amount of distension to which the cyst has been subjected. If it follows the operation of tapping, it will, as a rule, be recognized by the escape of more or less blood or bloody fluid at the time of operation, and the rapid refilling of the hydrocele sac or cyst with a more solid and opaque material.

To form a correct diagnosis of hæmatocele the history of the case is most important; indeed, more so than the local symptoms, for it is certainly true, that by the latter alone, in some instances, it is almost impossible to make out the true nature of the affection.

By way of summary it may be stated that a hæmatocele is usually a uniformly smooth, tense, and *non*-transparent tumor, with an *indistinct* sensation of fluctuation, but with *distinct* evidence of testicular pain on pressure. It may be accompanied with pain during the early period of the affection from the distension of the cyst, but not at a later date, or during its chronic stage, unless softening down. As time passes, it will become harder, if no symptoms of inflammation show themselves; but on their manifestation, evidence of suppuration will soon appear, for hæmatoceles have not, as a rule, a disposition to remain quiet like hydroceles, but tend to open outwards by the breaking up of the coagulated blood which has been effused, and the inflammatory process.

The symptoms which indicate the presence of a *hæmatocele of the spermatic cord* are somewhat similar to those already described for vaginal hæmatocele, the difference in locality being remembered. It is generally produced by a blow or strain, as in the ordinary vaginal hæmatocele. It can be diagnosed by the suddenness of its appearance, or the suddenness of the enlarged hydrocele sac, by the opacity of the swelling and tendency to consolidation which it possesses, also by the accompanying ecchymosis of the parts. Cases are recorded by Bowman, Curling, and others, in which this disease obtained enormous dimensions, but such examples are very rare; the affection being very uncommon.

On the source of the blood.—A very common question with students is, as to the origin of the blood in these cases of hæmatocele, and in the spontaneous cases and those following a strain or injury with an apparently sound testis, this question is difficult to answer with certainty of accuracy. There can be little doubt, however, that a distinct rupture of some of the vessels, probably veins, which ramify upon the body of the testis, or on the tunica vaginalis, must have taken place.

When occurring upon a hydrocele or after the operation of tapping, it is probably due to the distinct rupture or perforation of one of the large veins which ramify outside the tunica vaginalis, into its interior, or of one belonging to the body of the testis.

Scarpa relates a case of hæmatocele in which the spermatic artery was wounded, and Sir A. Cooper another in which a distinct rent in the tunica vaginalis was found on dissection. This latter condition is probably the most common.

TREATMENT.—The treatment of hemorrhage into the tunica vaginalis testis, or cord, differs in no respect from the treatment of hemorrhage into any other part of the body. In the very earliest period of its occurrence, rest in the horizontal posture, with the testicles well raised and the application of ice or cold lotion are the most efficient means to arrest the flow of blood and relieve pain. By such means, the blood may also be reabsorbed and all future mischief prevented. Should the blood, however, remain fluid for a long time, and no symptoms of reabsorption or of inflammatory action manifest themselves, it is a sound practice to draw off the fluid contents with a trocar and canula. I have had a case in which this course was adopted with good effect.

If signs of inflammation appear soon after its occurrence, cold lotions and leeches, with the aid of saline purgatives, may occasionally be found efficient in arresting its progress, and to allow of the subsequent reabsorption of the effused blood. But should symptoms of suppuration show themselves, or of the softening down of the coagula, a free incision into the cyst or tunica vaginalis is the only sound practice, the whole semi-solid contents being thoroughly turned out, and the interior of the sac allowed to granulate. In old and chronic cases, with thickened sac walls, the same treatment is also effectual. I possess the records of many cases in which this plan was carried out with marked benefit. In one case of only four months' duration, and in another of twenty-nine years, in which the tunica vaginalis was at least half an inch thick, and in both, a good recovery followed. I need hardly add that excision is rarely called for in the treatment of these cases, although owing to difficulties in the diagnosis it may occasionally have been had recourse to. I have seen several such instances, but beyond the loss of the organ no evil resulted. In old cases of hæmatocele in aged subjects, the practice of excision is probably the best; but in the young and middle-aged it cannot be advised. The treatment of hæmatocele of the cord is to be conducted on similar principles.

ON DISEASES OF THE TESTICLE.

On Inflammation of the Testicle.

Under this term *Orchitis*, most authors have been in the habit of including the inflammation of two distinct portions of the testicle, and of mixing up the symptoms of the two affections to the prevention of a sound and clear understanding of the subject. In this chapter I shall attempt to separate the two, and describe inflammation of the epididymis as one affection, and inflammation of the true secreting gland as another, calling the former *epididymitis*, and the latter *orchitis*. In certain cases, it is true, both structures are involved in the inflammatory action, and to this state I shall apply the term *testitis*; the three words accurately indicating the true seat of the malady, and their use, consequently, tending to facilitate its better study.

All surgeons will be ready to admit the distinctness of these two parts, anatomically and physiologically, viz. the epididymis and the gland. It is as well also to acknowledge that pathologically they are constantly divided, and I am certain that, to the student of the affections of this organ, such a division tends to a more ready discrimination and appreciation of the several diseases of the testicle.

As a preliminary to the more special clinical and pathological consideration of these diseases, the following observations of Sir J. Paget, as given by Curling, upon the development of the epididymis and testis may be read with interest and advantage.

Sir J. Paget observes "that, in the normal course of human development, the proper genital organs are in either sex developed in two distinct pieces, namely, the part for the formation of the generative substance, the testicle or ovary, and the part for the conveyance of that substance out of the body, the seminal duct or ovi-duct. The testicle or ovary, as the case may be (and in their earliest periods they cannot be distinguished) is formed on the inner concave side of the corpus Wolffianum, and the seminal or ovi-duct, which is originally an isolated tube closed at both extremities, passes along the outer border of that body from the level of the formative organ above, to the cloaca or common sinus of the urinary, genital, and digestive systems below. The perfection of development is attained only by the conducting tube acquiring its just connections at once with the formative organ, and through the medium of the cloaca with the exterior of the body. The sexual character is first established when, in the male, the formative and conducting organs become connected by the development of intermediate tubes which constitute the epididymis; or when, in the female, a simple aperture is formed at the upper extremities of the conducting tube, and is placed closely adjacent to the formative organ. In both sexes alike the lower extremities of the conducting tubes first open into the common cloaca, and subsequently, when that cavity is partitioned into bladder and rectum, or bladder, vagina, and rectum, they acquire in each their just connections, and become, in the male, the perfect vasa deferentia, and, in the female, Fallopian tubes or uterus."

I will remind the student that the epididymis naturally forms the posterior and outer part of the testicle, and the secreting portion or true gland, the anterior; that the former in a perfectly healthy state is only indistinctly felt, the vas deferens on being traced downwards from the cord losing itself as it were in this part. The body of the gland can always be made out by its smooth and elastic globular form.

On Epididymitis, or Inflammation of the Seminal Duct.

Inflammation of the epididymis may be caused by some local inguinal injury, or the pressure of a truss, but as a rule it is a consecutive affection, and occurs in association with gonorrhœa, or as the result of some irritation of the prostatic urethra, such as the presence of a calculus, or the passage of a sound or lithotrite. It is due to an extension of inflammation from the urethra down the vas deferens to the epididymis, and is an inflammation of the seminal *duct* and not of the seminal gland. It generally comes on suddenly, and is attended with considerable pain; a marked enlargement of the epididymis or posterior part of the testicle forming its chief local symptom. It is constantly preceded by severe pain in the anal and iliac fossæ, and accompanied by special tenderness of the part, this tenderness being readily traceable up the cord, which is occasionally swollen and œdematous. It is usually attended with œdema and redness of the scrotum over the inflamed tube.

The enlargement of the epididymis is very rapid, and in some instances very great. It invariably assumes a special outline when uncomplicated, that is, when confined to this special part, the epididymis appearing of a boat or truncated half-moon shape, holding the body of the testicle in its concavity. The lower portion of this body is usually the most enlarged, being composed of the greater number of the convolutions of the tubes, and consequently containing more connective tissue, since it is from the infiltration with inflammatory effusion of this connective tissue around the inflamed seminal duct that this enlargement is produced.

The affection generally is acute, comes on suddenly, runs a rapid course, and is accompanied in most patients by some constitutional disturbance. In some subjects this is very severe, while in others it is of a milder description, the sharpness of the inflammation and the peculiarity of the patients influencing the severity.

It is at times, however, complicated with other conditions, such as an inflammation of the true secreting portion of the testicle, but this complication invariably occurs as a secondary symptom, and is produced by the direct extension of the disease from the seminal duct to the gland. I have never seen a genuine orchitis or inflammation of the seminal gland as a result of gonorrhœa, except as an extension of the inflammation from the epididymis, and it is in quite exceptional examples of this affection that the body of the testicle is ever involved.

When the gland itself is inflamed, the diagnosis is readily made, the enlargement and great tenderness of the part clearly indicating what is the matter. The whole organ presents an expanded but flattened aspect, the swelling of the epididymis posteriorly, and of the body of the testis anteriorly producing this peculiar laterally flattened outline. The two inflamed parts will, however, be always felt distinct from each other, and can be readily distinguished. There is, however, a second complication of epididymitis, more common than that just described, which is, the effusion of fluid into the tunica vaginalis or the production of an acute hydrocele, and I am disposed to think, that it is this apparent swelling of the organ which has given rise to the mistaken idea, that true testitis is a common affection after gonorrhœa. The enlargement of the organ from such a condition is, however, very different from that already described as due to an inflamed gland. It is more globular, tense, and elastic; it is certainly equally painful with that affection, but its true nature can be readily made out by its translucency, and the presence of fluctuation on palpation. It is the result of a direct extension of the inflammation from the epididymis to the tunica vaginalis, and the following explanation of its occurrence by Gendrin, as given by Curling, who assents to its soundness, seems most satisfactory, since it is certainly borne out by clinical observation. He says "when the subserous cellular tissue, which always participates in the inflammation of a serous membrane, penetrates into the interior of an organ, it becomes a ready means of communicating the inflammatory action, but when the contiguous organ in subjacent parts is of a different structure from that of the cellular tissue, the extension of inflammation inwards is checked. Thus, in the case of the inflamed tunica vaginalis, the cellular tissue readily transmitted the morbid action to the epididymis, but the tunica albuginea arrested its progress to the body of the testicle, and this explains the fact that, after inflammation of the tunica vaginalis excited by injection, the body of the gland is rarely found to suffer. On the other hand, the epididymis is seldom attacked with inflammation without the disease being quickly propagated to the tunica vaginalis." The hydrocele, as a rule, however, disappears as the disease subsides in the epididymis, it being exceptional for the former condition to remain when its cause has been removed. As a consequence of this epididymitis, it is by no means uncommon for a considerable thickening of the seminal ducts and of their surrounding cellular tissue to remain for many weeks or even months. In the majority of cases, however, this result does not take place, for in the healthy subject there is every reason to believe, that with the inflammation all effusion disappears, and the organ is left as sound as it was before. In the cachectic patient this happy event does not, however, always take place, and more or less thickening of the inflamed part will generally be observed, the epididymis feeling indurated and enlarged, and in parts nodulated and cordy. It has been a disputed point by pathologists whether this condition ever leads to an atrophy or destruction of the testicles, or whether it has any influence upon the true function of the organ in causing sterility, and upon this point I have no positive facts to adduce, though I have certainly seen a wasting of the glandular structure of the testicles after inflammation, the result of an epididymitis. In one instance, I witnessed inflammation of the body of the testis in a young man who married at a time when he had a marked induration of the epididymis, the result of an attack of inflammation some months previously. I entirely attributed the inflammation in his case to the retention of seminal secretion from the obstruction to the seminal duct the result of the old epididymitis, since we know that all ducts or canals, when surrounded by organized inflammatory products, are liable to obstruction or stricture, and it is only right to believe, that the spermatic ducts are obedient to the same law, although this result may not be very common.

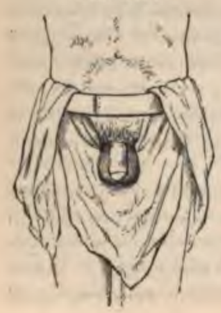
On the dictum of Sir A. Cooper, it has generally been asserted, that the left testis is more often attacked in cases of epididymitis than the right, but Mr. Curling, in his admirable treatise on the testes, disproved the truth of this assertion and showed that in 138 cases of this affection the right testis was the seat of the disease in 78 examples, the left in 49, and both glands in 11. My own figures, too, bear out the truth of these conclusions, for out of 73 consecutive examples of epididymitis, 35 were of the right organ, 25 of the left, 4 double, while in 9 the fact was not stated. *The right organ is, therefore, more often affected than the left*, while in hydrocele, the *left* side is the most frequent seat of disease.

With respect to the cause of the disease I took some pains during the eight years I was registrar at Guy's to find out if the general opinion was correct that the epididymitis usually supervened on the disappearance of the urethral discharge, and was relieved on its reappearance; or, if it could not be traced to any peculiarity in the treatment of the gonorrhœa, to any neglect, or other cause. I have to confess that I was not able to connect these phenomena in any way, as the epididymitis made its appearance during all stages of the complaint, and under every kind of condition; when injections were employed, and when they were not, when copaiba and cubebs had been taken, and when they had not, although in some cases the diminution of the discharge and appearance of the epididymitis were coincident; but such a result is only consistent with the general rule, that an inflammation set up in one part tends to relieve an inflammation existing in another, and more particularly in a neighboring tissue. The disease, however, appeared in a majority of cases of neglected gonorrhœa, and in others, in which strong injections had been recklessly employed; but more particularly in the cachectic and irregularly living patients who had been utterly regardless of their affection, and taken no means to keep the testes well suspended.

Treatment of epididymitis.—The treatment of this affection must depend upon the intensity of the inflammation and the severity of the local and constitutional symptoms which it produces. Rest in the horizontal posture with elevation of the testes or even of the pelvis, active purgatives, with saline medicines combined in acute cases with tartar emetic or colchicum wine are advantageous; the local application of ice, hot poppy fomentations, or swathing the parts in cotton wool, are often sufficient to check the disease at its onset, and prevent its passing into a chronic stage. It is also a wise measure to administer an opiate at night. When the local symptoms and pain are very severe, leeches may be applied to the neck of the tumor, or one of the turgid veins in the scrotum opened. The use of mercury does not appear to be of much value, except as a purge.

If the patient, however, from social reasons, objects or is unable to keep at rest, the parts must be well supported by a suspensory bandage, and a very efficient suspensor is formed by a handkerchief folded crossways in a triangle, the apex of which is well braced up posteriorly by a piece of tape, or bandage, and the base attached firmly to a band brought round the waist. The same treatment must then be pursued as we have already indicated. (Fig. 379.)

Fig. 379.



The treatment by compression, by means of strapping or an india-rubber bag has also been strongly advocated. I have used it but little in the acute affection, although in the more chronic or sub-acute, when the disease has passed into an inactive stage and little remains behind but the *product* of the inflammatory process, the treatment by pressure appears very valuable, indeed, more so than any with which I am acquainted; nothing tending more to hasten the absorption of the inflammatory product. (Fig. 383.)

Vidal's plan of puncturing the tunica vaginalis or even the testis itself, has been freely practised by some English surgeons, and Mr. H. Smith speaks highly of its value. I have, however, never seen a case calling for so severe a measure. When tension exists an incision into the tunica vaginalis may be made with impunity, but I should hesitate to puncture the testicle unless suppuration were present.

If mercury is ever needed in this affection, it is at the chronic stage, for as its power, doubtless, lies in its tendency to produce disintegration of inflammatory products, so it prevents the organization and subsequent contraction of such in and around the spermatic ducts which produces the special evil effects of epididymitis. When I have had occasion to use it, I have done so as an ointment applied with pressure to the part, but how far the good results which I have had from the practice has been due to the pressure alone I am unable to say. Of late, I have been accustomed to employ simple pressure in these cases, and have no reason to believe my success has been less favorable than previously.

If suppuration takes place as a consequence of epididymitis, a result which occasionally happens, it is well to open the abscess early, and freely, as by such a practice the discharge finds easy vent, and the formation of sinuses is prevented. Water dressing to the part, and the use of the suspensory bandage are the best subsequent local means, while tonics and good living are generally required.

ON ACUTE ORCHITIS OR INFLAMMATION OF THE SEMINAL GLAND.

Orchitis or inflammation of the seminal gland as an *acute* affection, for the most part, occurs as the result of an injury, but appears at times spontaneously without any such cause, and more particularly in connection with parotiditis or mumps. It may, too, be due to an extension of inflammation from the epididymis or spermatic duct, but it rarely, if ever, takes place as a primary affection in connection with gonorrhœa.

Acute orchitis may also attack the gland in its descent into the scrotum, and the following case illustrates this fact: Robert H——, æt. 12, was brought to me at Guy's Hospital on June 20, 1859; and as he walked into the room it was at once observed, that his body was bent unusually forward, and his movement much restrained. The *right* testicle not having descended from the abdomen could not be felt, and the *left* had first shown itself at the external ring three days before the boy's application. Pain in the groin, extended upwards towards the loin, having been experienced for two weeks previously. The testicle, which had passed down the canal and partially through the external ring was about as big as an egg, and remarkably tender. The horizontal posture was ordered to be maintained, with the thigh flexed, and cold lotion or ice applied. In three days, the symptoms had somewhat abated, and at the end of the week the swelling was much less. On July 11th, or the twenty-first day after coming under observation, the testicle had passed the external ring, although resting close to it in the scrotum. In another week, all pain had subsided; the testis was free, and the patient disappeared from observation, being quite well.

On August 16th, 1871, I saw with Mr. Forman, of Stoke Newington, a boy, æt. 14, with acute inflammation of the left testis, which was at the internal ring. It was accompanied with such severe local and abdominal pain, constipation, and vomiting, as to lead Mr. Forman to suspect the presence of a hernia. I saw the patient with these symptoms, and finding an inflamed painful inguinal swelling the size of an egg, I explored it with a scalpel, and discovered the tunica vaginalis filled with pus and a small undeveloped testis. All the symptoms speedily subsided after the operation, and a good recovery ensued.

The ***symptoms*** of acute orchitis are very marked and its diagnosis easy, for the rapid enlargement of the body of the gland, its flattened oval form, and extreme tenderness, are very characteristic. The patient will complain of its weight, and, if standing, will probably assume a bent posture. The disease will be accompanied by extreme local tenderness, and pain of a dull, aching character which passes up the loins, round the hips, and often down the thighs. The scrotum will probably manifest some symptoms of inflammation, such as swelling, redness, heat, and increased vascularity. In exceptional examples there will be some effusion of fluid into the tunica vaginalis, but this complication is not so common after acute orchitis as after epididymitis, for reasons which have been already given.

The constitutional symptoms will be those of gentle irritative fever, and vary according to the susceptibility of the subject of the disease, in some cases being very severe, and in others less so.

As a rule, it may also be asserted, that acute orchitis tends towards recovery and seldom terminates in suppuration, unless it be of the tubercular form, or affecting very cachectic patients. In one known example, it ended in gangrene of the part. This case was recorded by the late Mr. Harvey Ludlow in his unpublished Jacksonian prize essay. It was under the care of Mr. Stanley, who was induced to cut into the gland from the severity and obstinate character of the pain, and a black gangrenous cavity was exposed, which was seen after death to have occupied half the organ. I have the records of a case in which the patient stated that one testicle sloughed out after inflammation six months previously; the man came under treatment for inflammation of the other. The termination by suppuration, however, occasionally takes place, and numerous are the examples of this condition which I possess. These cases may also at times end favorably, the abscess healing without any evil result, but too frequently the discharge of the abscess ends in what has been variously described as benign fungus of the testis, granular swelling, or hernia testis. The latter is the most correct and intelligible name, the affection being the result of rupture or ulceration of the tunica albuginea, and the gradual extrusion or hernia of the tubuli of the gland, the extruded gland being covered with granulations. The true nature of this affection was first described by Sir W. Lawrence in 1808, 'Edinburgh Med. and Surg. Journal,' vol. iv, p. 257.

Acute orchitis as a consequence of parotiditis or mumps is a well-recognized affection, although it may be difficult to explain the connection between the two. It is described by some as a kind of metastasis, but there are no published facts tending to support this view; no one, however, being disposed to deny that the one affection occurs in connection with the other. The disease is not usually very severe, and commonly passes away with little treatment, leaving the testicle generally sound, few cases being recorded of atrophy of the glands attributable to this disease. The symptoms are precisely similar to those already described, and need no further illustration.

Treatment of acute orchitis.—The ordinary principles of treatment applicable to local inflammation in general are to be acted on in the treatment of this affection. Rest in the horizontal posture with elevation of the parts and warm fomentations are essential points for observation; leeching the groin or local venesection, and saline purgatives with sedatives are the chief remedies. The disease has a tendency to get well by itself, and unless badly treated or neglected, or attacking very cachectic subjects, this will generally be attained. In extremely severe examples, when the inflammation runs high, tartar emetic in full doses is a most valuable drug; while colchicum, in half-drachm doses of the wine, with saline purgatives, often acts like a charm. Opium in full doses may also be given where pain is severe, and constitutional disturbance great. An acute attack, however, generally runs its course in about ten days, and seldom ends otherwise than well. At other times, the local application of ice is most beneficial.

ON CHRONIC ORCHITIS.

Chronic inflammation is the most common of the true diseases of the seminal gland, and may follow the acute affection or an injury, but most frequently it is induced by some special constitutional condition, such as gout, tuberculosis, and more particularly syphilis.

The general symptoms of chronic orchitis, from whatever cause, are much alike, although they differ in some minor but important points. In the syphilitic affection, the symptoms are somewhat peculiar, and, as its diagnosis is important, it will receive special consideration. The subject will consequently be divided for consideration into the ordinary forms of chronic orchitis and syphilitic orchitis. Chronic inflammation of the testicle comes on most insidiously, and unless it follows an acute attack, is so unmarked by any special symptom, and unaccompanied by pain, that it is often only by the increased size of the gland that the patient is induced to seek advice. In some cases, however, this swelling is accompanied by pain of a dull and aching character. In the early stage of the disease the gland may be more or less painful on manipulation, but in a more advanced condition, or in a very chronic case, no local pain will be experienced even on somewhat rough manipulation, and in these examples even, on firm pressure, the ordinary testicular sensation will fail to be excited. The general appearance also of the testicle, the subject of this affection, is somewhat peculiar. It is not pyriform or globular as in hydrocele and many other affections of the gland, but has a peculiar flattened outline from side to side, and a smooth even surface, unless the disease be associated with some effusion into the tunica vaginalis, when the tumor will naturally assume more the shape of a vaginal hydrocele. But the simple affection is rarely associated with such a complication, and when it is, the fluid, as a rule, is secreted in very small quantities. The epididymis in exceptional examples, from the extension of the inflammation to its tissue may be slightly enlarged and thickened, but this never occurs to any great extent.

There are, also, seldom any constitutional symptoms worthy of remark, except in cachectic and irritable patients, when the dull aching pain of the part may give rise to some general irritability of the patient's condition, and an anxious expression of countenance.

The pathology of this affection is that of chronic inflammation of any other part, and consists in a more or less general infiltration of the gland with an organizable or organized material, the inflammatory effusion separating the secreting tubuli, and affecting them in ways determined by the amount of fibrin poured out between them and the amount of pressure to which they are subjected; the inflammatory product in some cases being very generally diffused between the tubuli, while in others it is deposited in irregular masses. When the material poured out is very great, and equally diffused between the meshes of the testis, *i. e.*, when the disease is extensive or of long standing, that condition of the gland is probably produced which is indicated by an utter absence of the natural sensation of the organ on handling, or on firm pressure, and, under such circumstances, there is the greatest anxiety for the subsequent maintenance of the integrity of the organ; though should the disease make a favorable progress towards recovery, and the inflammatory product be reabsorbed, the pressure will be proportionately removed from the delicate tubuli of the organ, and the natural testicular sensation be restored.

If the inflammatory product soften down, as it will in the delicate and cachectic subject, suppuration will take place, and in proportion to its extent will be the liability to a *hernia testis*.

Again, should this inflammatory product proceed to a more permanent organization and contract, the delicate tubuli of the testicle will suffer in proportion to the extent of the part involved, and an atrophy of the organ be the result as a consequence.

All these complications are met with in various degrees in practice, and with greater or less frequency, the general condition of the patient having a more important influence in determining the result even than the treatment; but I may add, that there are few affections which are more amenable to good treatment than that now under consideration.

When the disease is remarkably insidious in its advance, slow in its progress, and painless in its character; when the patient is cachectic and irritable, with anxious countenance, a disposition to a hot skin, and to other symptoms of constitutional irritation; and, more particularly, when the disease ends in suppuration, as in all probability it may when coming on and progressing in the manner just indicated, it is reasonable to believe that the organ is the seat of *tubercular mischief*, and that it disorganizes as a result. It must be added, too, that in these cases the tubercular affection is probably of the infiltrating or miliary tubercular form, and not of that crude nature which runs a different course, and to which attention will subsequently be directed.

In gouty inflammation of the organ, the symptoms, as a rule, are not so chronic as in the class of cases to which we have just alluded. Indeed they may more rationally be described as being of a subacute nature, for though generally coming on slowly, they are manifested by greater local tenderness and pain—the pain being considerably aggravated at certain periods, and most probably at night. The disease has, moreover, a strong tendency towards recovery, and not towards disorganization of the testis. Beside these symptoms, others indicating a gouty disposition will probably be present, such as acidity of stomach, a loaded condition of the urine, and a more or less distinct history of gout. There will also be frequent nocturnal pains of a darting character in the opposite testicle, leading the patient to fear a double attack, and when these pains occur, they are valuable in connection with others as diagnostic symptoms.

Symptoms and Diagnosis of Syphilitic Orchitis.

That syphilitic inflammatory disease may attack the testicle as any other gland or texture of the body, within or without, seems at the present day a tolerably well-recognized pathological fact, and the credit of bringing this subject clearly before the profession is largely due to my colleague, Dr. Wilks. I propose now to point out such symptoms as may aid in the recognition of syphilitic inflammation as affecting the seminal gland tissue. Before doing so it may be well briefly to consider in what way the syphilitic differs from other forms of inflammation, as such knowledge will help us to understand the local affection; and, fortunately, the points of difference are neither numerous nor deeply seated. The main one is palpable and apparent, for even to the most casual observer it is readily seen, that in all syphilitic inflammations there is a marked tendency to the deposition of a product which rapidly undergoes fibrous changes, and tends to infiltrate the part affected with an organizable or organized material of a dense, firm, and fibrous structure. We see this in every tissue and in every stage of the disease. We see it manifesting itself primarily by the almost cartilaginous hardness of the base of the true infecting chancre; we see it in the early constitutional symptoms of syphilis, in the different eruptions, and in the greater permanency of their skin staining; in the different affections of the mucous membranes in all their parts; in the inflammation of the eye, cellular tissue, periosteum, and bone. The pathologist sees it, moreover, in the varied changes found after death in the internal organs of the syphilitic subject; and the surgeon sees it, likewise, in the inflammation of the testes. For in the subject of hereditary or acquired syphilis, the testicle may, at some period of the disease, and generally at a late one, become the seat of a syphilitic inflammation, which manifests all the peculiarities of this pathological condition. The affection is essentially chronic, as much so as the other forms of chronic orchitis, but is almost invariably confined to the body of the gland, and rarely affects the spermatic duct. It is quite painless in its nature, local and general, the patient bearing free manipulation without flinching, and often thinking little about his disease, except from the increased size of the organ. The special sensation of the gland usually disappears at a very early stage of the disease, and there is rarely any constitutional disturbance accompanying its progress. It may or may not be associated with other symptoms of constitutional syphilis, but usually appears alone.

The disease manifests itself locally in a special manner which claims attention. It usually affects the body of the testis and both testes at different periods of its progress, though rarely at the same time. It is almost always complicated by the presence of a vaginal hydrocele, which at times increases to a considerable size, and much more so than in other forms of chronic orchitis. The most characteristic point of all, however, is the remarkable stony induration of the gland and its peculiar, irregular, nodular outline; small fibrous projections being distinctly visible from the body of the gland in some cases, while in others, loose bodies are felt in the tunica vaginalis.

In the majority of cases this disease terminates by resolution, and apparently leaves the gland intact; although in many, a gradual wasting of the testicle is the result, which ends in atrophy, and, as a consequence, in sterility. In exceptional cases, suppuration with or without hernia testis may take place. The disease, too, when apparently cured, has a remarkable disposition to return on the slightest provocation.

The treatment of chronic orchitis.—There are few affections more amenable to treatment than chronic orchitis, especially when taken early; and there are none which better prove the value of pressure and mercurials in procuring the absorption and disintegration of inflammatory products. In the common as well as in the syphilitic orchitis this opinion holds good; but, in the gouty, the treatment must be modified according to the special peculiarity of the patient. In a healthy subject with good powers and an unbroken constitution, any form of mercurial may be administered, such as blue pill in four-grain doses, mercurial inunction, the oleate of mercury or the perchloride; but as the object of the surgeon is neither to salivate nor to bring the patient rapidly under the influence of the remedy, but rather to procure a lengthened and equal action of the drug upon the local disease, the dose should be carefully regulated. In my hands, the iodide of mercury given in one-grain doses, with five grains of Dover's powder twice a day, or the mercurial suppository has proved eminently beneficial, the testicle being well strapped up by common soap plaster. (See Fig. 383.) In a more cachectic patient in whom mercury may still be tolerated, the same treatment may be employed, though in smaller doses; and in others, the mercurial may be locally applied in the form of an ointment, or as an oleate dissolved in oleic acid in the proportion of five per cent. During this time, tonics, such as quinine and iron, may be administered, as well as good living and fresh air enjoined.

In certain examples, however, occurring in cachectic patients, it may not seem desirable to administer mercurials in any shape, and, under such circumstances, iodine may be substituted in the form of the iodide of potassium in three- or four-grain doses, gradually increased to ten or twelve, combined with half-drachm doses of the syrup of the iodide of iron in infusion of quassia, three times a day. Locally, strapping, or rather pressure, should still be enforced. In hospital practice, this treatment has been of great value; by it, steadily persevered in for six or eight weeks, even the worst of cases may be expected to yield, the organ gradually becoming softer and more natural in sensation and shape, and at last resuming its normal condition.

In the gouty form of orchitis which can be recognized or suspected by the symptoms already quoted, the administration of colchicum is very beneficial. It should be given in small doses, and continued for several weeks. The acetic extract in half-grain doses, with Dover's powder is the best form, and with it a cure may generally be guaranteed. This form of disease is easily reduced when early recognized. It is more liable, however, than other forms to relapses, but less so to disorganization and subsequent atrophy.

If there be sudden accessions of pain in the part, with other evidences of some fresh inflammatory attack, the application of a few leeches with hot fomentations is very serviceable, but these conditions are uncommon.

When vaginal hydrocele coexists with the inflamed gland—a frequent complication of the syphilitic variety—it is a good practice to draw off the fluid, to enable the surgeon to apply his pressure with more certainty and better effect. It is of no use to attempt to cure the hydrocele itself, as it must be remembered that the hydrocele is the direct consequence of the diseased testis, and that it is of little use to treat the effect of a diseased condition and not its cause. Remove the latter, and the former will probably disappear; cure the orchitis, and the hydrocele will generally depart.

I have the records of a case which passed under my care for treatment, where by some oversight this attempt had been made, and the hydrocele was tapped and injected with iodine on three different occasions, without success. Under the subsequent treatment, the chronic orchitis disappeared, and with it the hydrocele.

It is not always desirable, nor is it possible in a large proportion of cases, to keep the patient absolutely at rest during the process of treatment. In some it is advisable to do so as much as possible, particularly when the patient experiences more pain and inconvenience when walking or moving about, but, in the majority of cases, it is sufficient to keep the parts well supported by an elastic bandage or strapping.

In the consideration of the treatment of chronic orchitis it has been stated, that a good recovery may generally be secured by the means which have been suggested, when the disease has been taken in hand at an early period of its existence; that is, when not more than five or six weeks have been allowed to elapse. But in case of longer standing, the prognosis is not so favorable either as regards the removal of the disease, or the subsequent integrity of the part as a seminal gland. These remarks apply more particularly to the syphilitic form of the affection; for, if of long standing, the fibrinous matter has generally become too well organized for future absorption, and when this is the case, the subsequent contraction of the organized product will almost to a certainty go on to the destruction of the seminiferous tubuli, and an atrophy of the gland. In Guy's Hospital Museum are several admirable specimens exhibiting this result.

Again, in certain examples of chronic orchitis, whether syphilitic or otherwise, suppuration and disintegration of the gland structure will take place. This termination may be suspected when the disease is of a very torpid character, the pain of a constant aching kind, and when all treatment fails to influence its course.

When pus has formed, its early evacuation is the best practice, as a clean incision or puncture into the part often prevents that destruction of the glandular structure and its fibrous covering which usually precedes that troublesome affection, hernia testis.

ON TUBERCULAR DISEASE OF THE TESTICLE.

Tubercular disease of the testicle may attack any part of the organ—that is, either the seminal gland or its duct—or it may affect these parts separately or together. It may show itself either in the form of an infiltration of the so-called miliary tubercles, or in the more distinct and usual condition of the yellow, cheesy, unorganizable material described as crude tubercle. When it appears in the form of miliary tubercle, it is not characterized by any very definite symptoms; indeed the infiltration of a gland with those small, gray, miliary bodies seldom makes itself known by any outward visible signs, and their presence should be suspected only when a rapid disorganization of the part takes place, after an attack of acute or chronic inflammation. Organs thus infiltrated have no power of resisting the inflammatory process, and, whether it be a lung or a testicle which is the seat of this affection, active breaking up of tissue with suppuration generally ensues. I shall exclude from present consideration those interesting cases, remembering that pathologically they are clearly to be recognized, while practically their presence can only be suspected when the result to which I have already alluded takes place.

The other form of tubercular testis is characterized by more special symptoms and local conditions. It may involve, as already stated, either the body of the gland or the epididymis, but, doubtless, the latter is the more frequently diseased. It is generally discovered accidentally by the patient, and frequently not until some secondary change in the structure is about to show itself. It appears primarily as an indolent, painless enlargement of the epididymis, and is described usually by the patient as a lump in the testicle, this lump appearing generally at the upper part. This symptom, in all probability, is the only one to which attention can be drawn, and the surgeon will recognize it at once on manipulation, for the tubercular matter will feel as if some foreign body, as a pea, bean, or nut, had been placed between the convolutions of the epididymis, or in the substance of the gland. The gland is not painful on pressure, nor in its inactive stage does the disease seem to cause any injurious influence on the organ, which is otherwise natural in its sensation and function.

In other cases, the disease will appear as a general infiltration of the part involved, and should this be the epididymis, it will be enlarged, indurated, and nodular, painless perhaps, and inactive, the body of the testis, apparently sound, resting on the concavity of the affected portion. If the body of the gland be the part affected, like symptoms will be present, although the enlargement will show itself as a uniform or nodulated expansion of the secreting structure; the epididymis, or seminal duct, being quite distinct.

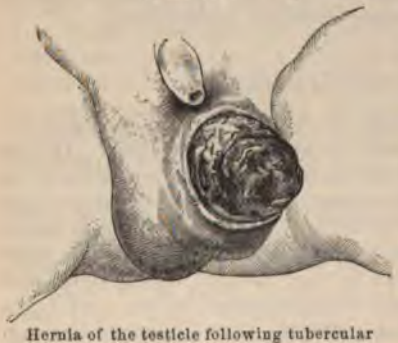
This inactivity of the disease, however, does not remain always, though it may last months, or even years—but the time will come, when the tubercular matter, in all probability, will soften down, and thus excite some increased action in the parts around. It may be that this increased action in the part will first draw the patient's attention to his affection, when the history of some previous thickening of the organ will for the first time be obtained. When inflammatory symptoms are once developed, the disease will certainly make rapid progress, and disintegration of this unorganizable tubercular matter accompanied by suppuration will speedily follow.

In tubercular epididymitis—for such this disease may be named—local suppuration will soon appear, with the discharge of ill-formed pus and débris, as a curdy, friable, and granular material; and after this, sinuses are apt to form, which may go on discharging for a period, depending on the extent of the disease, and the amount of foreign material existing to disintegrate and soften.

If the body of the testicle be the part implicated, the same gradual softening and suppuration will take place, but too often it will be followed by the formation of the hernia testis to which allusion has been already made. It is not, moreover, in every case of this disease of the testis that disintegration of the tubercular material is to be expected, with its accompanying suppuration and abscess; for in many examples, no such result can be found, this tubercular matter undergoing a gradual change, and showing itself after death as an earthy concretion. The same changes take place in the testicle as are seen in the absorbent glands, the lungs, and other parts.

Tubercular disease of the testis may occur at any age, but is more common in adult life. The best example that I have seen was in a child, aged two years, whose testicle I excised for disease of six months' standing, which had progressed very slowly and acquired a large size before suppuration occurred. Convalescence followed the operation. (Fig. 380.) The whole organ, with the epididymis, was nearly filled with scrofulous deposit. It is in the testicle that we have the best opportunity of examining the true tubercular disease in its different stages, and of watching the various form of its deposition, its changes, and decay.

Fig. 380.



Hernia of the testicle following tubercular disease.

Treatment of tubercular disease of the testicle.—When tubercular material has been once deposited in a testicle as in any other tissue, there are no recognized means by which the absorption of this material can be procured. It is true that it may remain in an inactive or passive condition for an indefinite period, and finally, by undergoing an earthy degeneration, cease to trouble; nevertheless, it will still exist, ready as it were, on the least disturbance, to light up some inflammatory action in the tissues around, and to give rise to any or all of the various conditions just described.

Looking also upon the deposition of tubercle in a testicle as only one of the local manifestations of that general condition described as tuberculosis, it is clear, that the principles of treatment should be of a general character to improve the health and revive the powers of the patient by tonics, good living, good air, regular habits, and, what is of great importance, total abstinence from sexual excitement or gratification. Indeed the parts should be maintained as much as possible in a quiet condition, and for this purpose, cold sponging night and morning is of some service.

When inflammatory symptoms make their appearance, they will generally run their course in spite of treatment; for, as already shown, they are usually caused by the breaking down of the tubercular deposit, and may be looked upon as one of nature's means for its elimination; indeed, until this material has been discharged, their subsidence is not usually to be expected; fomentations in this stage and the application of water dressing to the part are, therefore, suitable, while support in a suspensory bandage should be resorted to. When suppuration is nigh at hand or has manifested itself, it is good practice to open the abscess freely with a lancet, as it saves time and pain to the patient and often prevents the formation of the sinuses which proves so troublesome. During all this time the health of the patient must be attended to by ordinary measures.

When the gland has attained a large size and is evidently destroyed by abscesses and disintegration of the infiltrating material, it may be excised, and more particularly if hernia testis has appeared and the disorganized testis is a source of trouble and weakness to an enfeebled patient.

On Hernia Testis.

This affection, which has been variously described as "granular swelling," and "benign fungus, of the testis," has also more correctly been called "hernia testis," for it is essentially a gradual protrusion of the substance of the gland through a rupture or ulceration of its fibrous envelope, the tunica albuginea. It may follow upon suppuration of the body of the gland the result of an injury, or of an acute or chronic orchitis, or from the softening down of tubercular deposit. It seems to be the result of pressure produced by the natural elasticity of the fibrous tunica albuginea; the testicle, as it were, being gradually squeezed out of its capsule and everted, the mass being eventually increased by the free granulations which spring up on its surface. The whole organ, or only a portion of it, may thus be extruded from its natural position, the extent varying according to the amount of disease and the size of the opening in the tunica albuginea and integuments. It must not be supposed, however, that this hernia testis is the necessary consequence of suppuration or of disorganization of any portion of the gland, for such is not the case. In the majority of instances it does not ensue, though in some it is certainly found, and in such requires consideration.

The diagnosis is not difficult, and the disease having been once seen subsequently can be readily made out. It is a peculiar fungating-looking growth with everted edges and a sinus in its centre generally secreting pus. It is of variable extent, and presents a more or less irregular surface and a pedunculated base, the pedicle passing through an opening in the scrotum to the remains of the testicle. The margin of the opening in the scrotum is generally free, although in some cases adherent to the growth. It may be slightly indurated from inflammatory thickening, but will never present the same aspect as a cancerous growth, for which, however, this affection may be mistaken, the term "fungous testis" having doubtless been the means of encouraging the great error of regarding this simple disease as malignant. The natural sensation of the gland remains, however, in these cases, and will be readily excited by manipulation, whereas in cancerous disease, no such natural sensation exists, and, in doubtful cases this point is one of primary importance.

Treatment of hernia testis.—It may be safely stated that the majority of cases of hernia testis can be successfully treated by other less severe measures than castration, although this operation has been very generally performed for this affection. In exceptional instances it may be demanded, and I have the records of many in which it has been successfully performed. The surgeon's object, it may be briefly stated is, to restore the extruded testicle to its natural place, which may frequently be done by simple pressure applied by fixing a good firm pad over the surface of the growth and drawing the margin of the ulcerated scrotum well forward, fixing the whole in position by strapping. In other cases, where the granulations are very exuberant, caustics may be used to hasten their destruction; and among the best is the red oxide of mercury, pressure being well maintained during its use. All minor cases, and many of the severe, may certainly be cured by these means, if steadily pursued and well applied. In the more obstinate and severe examples other measures must be adopted. The excision of the surface of the growth was formerly employed, and is occasionally in the present day, but the practice at best, is a very doubtful one, for in the majority of cases to which it is applicable it would be tantamount to castration, as the fungating mass is, as a rule, composed of the everted tubules of the testis, covered with granulations, and consequently, by this measure, the tubules would be cut off and the gland destroyed.

Mr. Syme described in the 'London and Edinburgh Monthly Journal' for January, 1845, a plan of treatment which in these cases is very serviceable, although it is only in quite exceptional examples that it can be called for. The operation consists in the elevation of the margin of the scrotum from the protruding mass, the reduction of the hernia testis within the scrotum, and the retention of the part in its natural position by a stitching together of the margins of the wound, careful bandaging and strapping being also required in the treatment of these cases. The granulating organ becomes attached to the inner surface of the scrotum, and a healthy action is subsequently restored. It is almost needless to add, that a local and constitutional treatment for the original affection of the testis should at the same time be maintained.

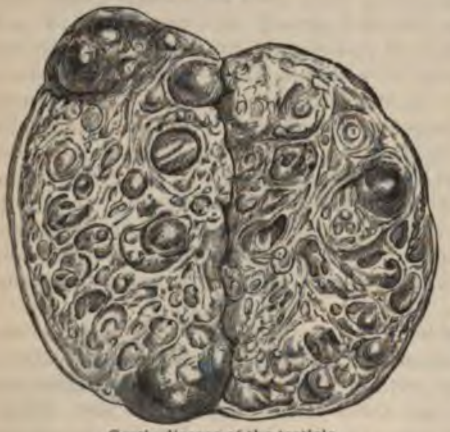
ON CYSTIC DISEASE OF THE TESTICLE.

There is no affection of the testicle on the nature of which there has been a greater difference of opinion than cystic disease, and although modern pathologists have devoted considerable attention to its investigation, the subject has not yet been brought out of its obscurity and made plain to the profession.

Sir A. Cooper, one of its original inquirers, looked upon it as a distinct disease of the secreting *tubuli* of the organ, and upon his authority, this view was for a time generally received. More recently, Mr. Curling's researches have tended to prove it to be an affection of the *ducts* of the testicle, and not of its secreting tubuli. "Why they alone," says Mr. Curling, "are subject to the morbid change, I admit my inability to explain." Whether this opinion be correct or not will be one of the subjects for present consideration; since I am disposed to think, that it is not quite consistent with observed facts, although there can be no doubt that the rete testis appears to be the seat of the disease in certain cases, while in exceptional examples, cystic disease is undoubtedly formed independent of this structure.

It has been my privilege to examine many examples of this rare affection with some care, and I entirely concur in the main points of Mr. Curling's investigations although I am not so sure of the special seat of the disease as he appears to be. It is doubtless made up of cysts which are multilocular and of sizes varying from that of a mustard seed to a moderate-sized nut. (Fig. 381.) These cysts are filled with a thin, serous, blood-stained, or glairy fluid, and at times with more or less pedunculated intra-cystic growths made up of a delicate cellular structure, or of a distinct cell tissue. These cysts appear embedded in a fibrous stroma of different degrees of consistency and density—the fibrous elements in some being much more numerous than in others. Whilst in some again it will be of a more delicate nature, and more allied to the fibre structure found in the ordinary fibro-plastic growths of other parts. In certain examples, the cysts are clearly made up of dilated tubes with pouches at their extremities, or, as lateral dilatations—these tubes being occasionally lined, as Mr. Curling was the first to observe, with tessellated epithelium and containing granular matter. I have failed, however, to find this in all the cases I have examined, and am disposed to look upon the presence of this tessellated epithelium as specially characterizing a certain growth. Spermatozoa are invariably absent in the cysts or tubes of this affection, while cartilage or bone elements will almost always be found to exist either as small isolated patches or as filling the cyst, when the growth might be described as an enchondromatous tumor, the cartilage being deposited

FIG. 381.



Cystic disease of the testicle.

in separate masses, and these masses being divided by a fibrous stroma. The true secreting portion of the testicle will often be found pushed up into some corner of the tumor, spread out over the cystic mass, or distributed between the cysts themselves, the tumor being invariably encysted in its own capsule; although, in rare cases, tumors of this nature will be found upon the cord and body of the testicle. The above facts, therefore, lead me to conclude that the majority of these are new growths following the great law which governs the development of all tumors, by taking on the likeness of the part in which they are developed, and that they are more or less built up as is the structure of the normal gland. The testis being essentially a tubular organ, all morbid growths developed in or near it have a tendency to assume a tubular or cystic character, this character varying in extent in different cases; the cystic or tubular and fibrous or fibro-plastic structure being found in different degrees of perfection and quantity in different cases.

We may thus find in the testicle, a tumor presenting all the elements of the fibrous or fibro-plastic tumor without cysts, whilst in another, in which the cystic formation more or less predominates, the same elements will exist in smaller proportions; and, in the majority of these examples, the true structure of the testicle will be found spread out to a variable extent over the special capsule of the new growth. In other cases, the new growth will be altogether free from any connection with the testis itself, and be found growing from the cord. All these separate kinds of tumors, examples of which may be seen in Guy's Museum, appear to me merely modifications of one kind of growth—the simple, or perhaps more correctly, adenoid growth of testis.

We thus see a close analogy between these tumors of the testis and those of the mammary gland, as well as of the ovary, and find in all the simple adenoid tumor partaking more or less of the nature of the gland in which it is developed; and also a true cystic disease of the gland itself, the latter being evidently a special affection of the tubes and ducts of the mammary gland or testis, and not of the secreting structure. In both organs they are new growths, simulating, more or less correctly, the anatomical structure of the true gland.

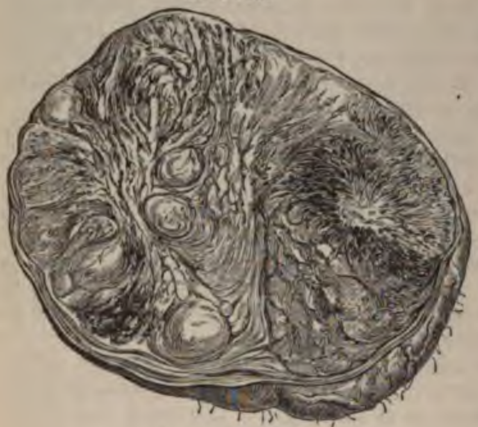
Symptoms and diagnosis.—Having described the special pathology of this disease, I pass on to consider its clinical aspect, as well as to point out the symptoms which indicate its presence, and help the formation of a correct diagnosis. In doing so I must premise, that the several forms of this cystic disease are to be recognized more by negative than by positive signs, since they appear usually as painless enlargements of the organ, are of slow growth, and unaccompanied by any such symptoms as attract attention—the patient, indeed, seldom seeking advice until the organ has become troublesome from its size, or the dragging pain in the loins excites anxiety, which always exists when the testicle has become large and heavy from any cause. The testis soon loses its natural shape, and assumes more the oval or pyriform outline of a vaginal hydrocele or hæmatocele. It will probably have a smooth and equal surface, and be indistinctly fluctuating, though not translucent; while its natural sensation experienced on manipulation will most likely have disappeared at a very early stage of the disease. The general health of the patient may probably be good, and there will be no evidence of any secondary glandular affection. By these conditions the disease may generally be recognized, the history of the case, the opacity of the tumor, and the loss of the natural testicular sensation, distinguishing it from hydrocele and hæmatocele; and when doubt exists, an exploratory puncture by the trocar and canula will decide the point, for in cystic disease a little bloody and glairy fluid will alone escape. From the inflammatory affections it may be diagnosed by the difference in the shape and feel of the tumor, for in the different forms of orchitis the organ maintains its flattened form from side to side, feeling hard, nodulated, and tender. In the cystic disease, the tumor is generally more or less globular or pyriform, smooth, elastic, and without the peculiar testicular sensation. The inflammatory affections are also often associated with a hydrocele, and the cystic but rarely, if ever. In the former, also, both organs are generally affected sooner or later; while in the latter, the disease only attacks one. Medical treatment does not appear to have any influence in arresting the development of the cystic, whilst in the inflammatory disease a good recovery may generally be secured by the use of proper remedies.

Treatment of cystic disease.—There is but one remedy, which is the removal of the diseased organ. No drugs seem to have the slightest effect in diminishing its size or arresting its growth. Excision, therefore, should be performed, the operation being, as a rule, most successful.

On Cancer of the Testicle.

The testicle, like all glands, may become the seat of cancerous disease, both of the carcinoma-fibrosum or hard cancer, and of the carcinoma-medullare or soft cancer. It is rare, however, for the hard cancer to attack the testis, the majority of examples being of the soft or encephaloid form. For one example of the hard cancer it is probable that at least twenty of the soft are met with in practice. In the different museums a few specimens of the former kind may be seen, and at Guy's several exist.

Fig. 382.



Cancer of the testicle.

Cancer may also attack this organ in two forms, either as the tuberous or the infiltrating cancer. In the former, the disease appears either as an isolated growth, or as several distinct tumors separating the parts and then eventually coalescing into one mass; in the latter, it appears from the beginning as the infiltrating kind, the cancerous elements being more equally distributed between the tubes and ducts of the true secreting gland tissue.

The malignant affections of the organ, as the simple, are accompanied by the development of cysts, and these, in the malignant cases, are filled with cancerous matter in lieu of the glairy mucus or fibro-cellular intra-cystic growths which are found in the fibro-plastic, adenoid, or cystic diseases. In rare examples, both conditions seem to coexist in the same organ; simple cysts, with the clear or blood-stained glairy fluid, being found in one portion, whilst in others, these cysts are filled with cancerous material, and in a third, enchondromatous masses may at times be present. (Fig. 382.)

The part of the organ generally attacked is the body of the gland, although the epididymis may be the seat of the disease; but when the latter is involved, as a rule, it is an extension of the disease from the body of the tumor. Rare examples, however, exist which illustrate a primary affection of the epididymis.

Cancer may attack the testis of the old as well as of the young, and I have the records of cases occurring in men aged 56 and 62, respectively. Instances of this disease attacking infants even so young as seven months have likewise been recorded by different authors, and I have excised a cancerous testicle from a boy only two years old. The majority of cases occur, however, in young adult life, from 25 to 40 years of age, as is indicated by the following facts.

I possess the records of twenty-five cases, which I have added below to the fifty-one examples originally tabulated by Mr. Harvey Ludlow, in his Jacksonian prize essay. The results are as follows:—

Before the age of 5	6 cases.
From 15 to 20 years	2 "
" 21 to 30 "	17 "
" 31 to 40 "	31 "
" 41 to 50 "	11 "
" 51 to 70 "	9 "
	76

Out of my 25 cases the disease in 20 had been growing for one year or less, and in the remaining 5 cases two were of three years, two of four, and one of five years' standing.

It is rare, if not unknown, for both testicles to be the seat of cancer at the same time. I am not aware of any such example being on record. In 16 out of the 25 cases before me, the right organ was attacked, and in 9 the left. Mal-placed testicles appear to be particularly prone to this disease.

Cancer of the testicle may come on as insidiously as the simple cystic disease, but in general its growth is more rapid. It makes its appearance as a gradual enlargement of the body of the organ, seldom attended by pain. There is also an early loss on pressure or manipulation of the special testicular sensation. The outline of the tumor is smooth, semi-elastic, and fluctuating, but as the disease progresses, its surface may become somewhat uneven or irregularly bossy, the tumor being harder in some parts than in others, the softer parts projecting. In the carcinoma fibrosum, however, the whole tumor is hard and at times nodular. The tumor is opaque from the beginning, and rarely, if ever, associated with hydrocele, and when so, it is by chance, the one affection having no direct relation to the other. In this respect, cancer differs from inflammation of the organ, which is very frequently complicated by the presence of hydrocele.

The disease rarely extends beyond its fibrous covering or involves the scrotum; and for a bleeding fungus to form, the tumor must be very large. As the disease progresses, the health of the patient may suffer, and a general aspect indicative of exhaustion and some wasting disease appear, although it is not till a late period of this affection that any such symptoms are to be expected. When lumbar pain or a constant aching exists, a suspicion of enlarged lumbar glands should be excited, and, in certain examples, a chain of enlarged glands may be felt extending upwards along the psoas muscle.

The inguinal glands are occasionally enlarged from infiltration, though it is believed by some that this complication does not appear till the scrotum is involved in the disease. This, however, is certainly not the case, for large inguinal glands may appear at an early stage.

The diagnosis of the disease is by no means easy, particularly in its early stage, indeed, in many instances, it is almost impossible to be certain of its nature. It is the size of the organ which generally first draws the attention of the patient to the part; and the pain and inconvenience caused by its weight which prompt him to seek advice.

The history of the case and the absence of translucency will prevent its being mistaken for a hydrocele. Hæmatocele, as a rule, has a distinct and special history of its own, and the fact that the testis may be made out to exist in some portion of the tumor is a material aid to the surgeon in forming a correct opinion as to the nature of the case.

The tenderness of the organ, the nature of the pain, and the shape of the swelling, are sufficient to indicate the inflammatory affection, and when fluid exists, the diagnosis is rendered more plain, since a vaginal hydrocele rarely coexists with any other disease than the inflammatory, except to a very slight extent.

The simple cystic disease is of slower growth than the cancerous, and generally firmer to the feel; when punctured, it yields also a glairy fluid unlike the creamy material which comes away from the cancerous disease. The subject of diagnosis of all these growths will, however, be discussed hereafter.

Treatment.—The only treatment which gives any comfort to the patient is excision of the organ, and this should be done as early as the diagnosis can be made, for there is then less chance of the glands in the loins becoming involved. The general health must also be attended to with great care at the same time.

On the Diagnosis of Scrotal Tumors.

I propose now to consider the subject of the diagnosis of scrotal tumors as a whole, to describe the train of thought which passes through the surgeon's mind when examining such a case with diagnostic intentions, and to point out the special symptoms or their combination, as they tend to indicate the presence of any special affection. In doing this, I believe that a near approximation to truth may generally be made, when the history of the case and its special symptoms are carefully weighed. Great difficulty may occasionally be experienced in any given case, or it may be beyond our power to form any positive opinion upon its nature, but I am not disposed, on that account, to place among impossibilities the diagnosis of a scrotal tumor. There are gradations of probability in all our conclusions as to the diagnosis of any disease, and a certainty untainted by fallacy or doubt is rarely obtained; but I take it, we are as often correct in our judgment of a scrotal tumor as of any other affection. To aid the student in this task the following table has been drawn up. (P. 664.)

The first point the surgeon has to decide on being consulted as to the nature of a scrotal tumor has reference to the question of hernia. Is the tumor connected with the testicle? or has it passed down the direction of the cord from the abdominal cavity? If the surgeon is able to isolate the growth at its neck from the abdominal cavity by the thumb and finger, the question is at once decided, for almost all scrotal tumors can be so isolated, it being quite exceptional for any to pass up the cord so for as the internal ring. Rare cases of vaginal hydrocele, or hæmatocele, however, in which the tunica vaginalis is open up to the internal ring, form an exception.

Table of Diagnosis of Chronic Disease of the Testicles.

Symptoms.	Hydrocele.	Hæmatocele.	Chronic orchitis.	Syphilitic orchitis.	Tubercular disease.	Cystic, or adenoid disease.	Carcinomatous disease.
Condition of tumor	Tense, usually transparent, fluctuating	Tense and elastic; *not* transparent; *obscure* fluctuation	Firm and not elastic; *not* transparent; not fluctuating unless complicated with hydrocele	Very solid, but not elastic or transparent unless complicated with hydrocele, which is very general	Indolent indurations in body of gland or epididymis, like foreign bodies. Towards the end these bodies soften and excite suppuration	Firm and elastic; insidious enlargement of gland; not translucent; indistinct fluctuation	A tense and firm enlargement of body of testis; not translucent. Indistinct fluctuation towards later stage; bossy outline; parts softer than others.
Outline	Smooth and uniform	Smooth and uniform	Smooth and compressed laterally	Irregularly nodular and very hard	The epididymis most frequently involved	Generally regular, smooth, and elastic; rarely bossy	
Position of testis	Posteriorly in *vaginal*. Anteriorly at side or below in *encysted*	Posteriorly	Evidently an enlarged testis	In tumor	In natural position, often half surrounded by epididymis as a half crescent	In tumor	In tumor.
Testicular sensation	Present on manipulation	Present on manipulation	Present at first; absent after long existence of disease	Absent altogether, except in very early stage; returns also towards convalescence	Present	Present at first, but soon lost	Soon disappears.
Rapidity of growth	Gradual, most so in *encysted*	As a rule sudden, and after accident, at times spontaneous and gradual	Slow	Slow in the extreme, often hardly noticed	Slow at first; rapid afterwards, when softening and inflamed	*Unequal;* slow at first, more rapid afterwards	Rapid, as a rule; slow only in the carcinoma fibrosum, which is very rare.
Size	To great dimensions in *vaginal;* moderate in *encysted*	Moderate	Rarely more than 3 or 4 times natural size	Moderate	Moderate	Rarely, but sometimes very large	Sometimes very large.
Form	Pyriform or oval in *vaginal;* globular in *encysted*	Pyriform or oval	Oval with flattened sides	Irregularly oval and lumpy	Lumpy; uneven in all its stages	Oval with flattened sides. Smooth at first, subsequently bossy	Globular or pyriform. Smooth at first, subsequently lumpy, softest at these points.
Pain	Very slight, if any, except when complicated with inflamed testis, & in acute hydrocele. Not increased on pressure	Painful at first and at a later stage; not so during the intermediate	Dull pain, increased on pressure, except in very chronic disease	Very slight, allows rough handling. Towards end of disease, on recovery, pain on pressure returns	Very slight pain or tenderness, except when pressed hard or inflamed	Slight when present; generally painless even on manipulation	Very slight, even on free manipulation.
Manipular indications	Like fluid, vibration on palpation	Firm and solid	Firm and solid, unless associated with hydrocele	Very hard and irregular outline. Often hydrocele, with small fibrous bodies in tunica albuginea	At *first* as if foreign bodies existed in the parts, lumpy. *At last* soft before suppuration	Firm and elastic, more so in one spot than another	Firm, but elastic; softer on the bosses, when present.
Seat of its commencement	In *vaginal*, at the lower part of the tumor. In *encysted*, at the upper	......	Evidently in body of gland	Always in body of gland	Generally in epididymis; occasionally in body of gland	In body of gland	Body of gland.
Cause	No recognized cause	An injury or strain, rarely spontaneous	Injury; or idiopathic	Constitutiona syphilis, hereditary or acquired	Tuberculosis	Unknown	Unknown; occasionally from injury.
Progress	Has a tendency to remain tranquil, and not to inflame, unless injured	Has tendency to inflame and suppurate, and not to remain tranquil for long	Slow growth; rarely, but at times ends in suppuration	Essentially chronic; rarely terminates by suppuration	Very indolent and insidious; tends to inflame and suppurate after an uncertain period	Unequal; never inflamed	Rapid as a rule; rarely slow.
Condition of cord	Free and healthy	Healthy	Often full and tender on manipulation	Free	Healthy	Healthy	Full; veins enlarged.
Results of tapping, exploratory or otherwise	Straw-colored fluid, serous in *vaginal;* limpid, opalescent in *encysted*	Blood fresh, or broken up with pus	......	......	......	*Mucoid fluid*, more or less blood-stained	*Blood* or *creamy fluid*, with characteristic cell-growth on microscopical examination.
Condition of inguinal and abdominal glands	Free and healthy	Healthy	Healthy	Generally indurated	Generally indurated	Rarely involved	Generally involved.
Complications	Inflamed testicle	None, unless hydrocele, or injured testicle	Occasionally with hydrocele	Hydrocele, almost always. Other syphilitic affections	Rarely with hydrocele. Disease in other parts of body	Rarely with hydrocele	Cancer in other parts; rarely with hydrocele.
Organs involved	Occasionally double	Never double	Generally both organs either separately or together	Often both organs	Both organs, as a rule, involved	Always single	Single as a rule.

It being determined that the swelling is not a hernia, the nature of the tumor next claims attention.

Is it a hydrocele or hæmatocele? Is it the product of inflammation or of tubercular disease? Is it a new growth altogether, and, if so, is it innocent in its nature or malignant?

If the tumor prove translucent by transmitted light, the existence of a hydrocele is fairly decided; but, then, is it an ordinary vaginal hydrocele, or encysted? Should the tumor be large, even, and pyriform, and the testis be found, at the posterior part of the tumor either by means of manipulation or by the opacity displayed at one spot on transmitting light, vaginal hydrocele may be suspected; but should the testis exist in front or at one side, and the tumor have been of very slow growth, small, and more or less globular or evidently multilocular, a cystic hydrocele may probably be diagnosed. The tapping of the tumor will, however, settle the diagnosis; for in vaginal hydrocele the fluid will be more or less straw-colored and albuminous, while in the encysted, it will be thin, non-albuminous, pale, and probably opalescent, containing on microscopical examination, granules and spermatorrhœa.

In rare or old instances, however, the tumor may be opaque, and under such circumstances, difficulties may be experienced; yet the history of these cases will tend to throw much light upon the point, for to a certainty it will reveal a disease of very long standing; the tumor will be probably painless and fluctuating, and the testis made out to be in its usual position at the posterior part of the sac. When a doubt exists, a puncture with an exploring trocar and canula will decide the question, as in these cases, fluid will be drawn off of a dark color, loaded with cholesterine.

We will now pass on to the consideration of tumors which are not translucent and not hydrocele, and it is here that the surgeon experiences true difficulty in his diagnosis, as almost all the diseases of the testis are insidious in their growth, and chiefly painless in their development. The hæmatocele, except in rare examples, usually follows upon some strain or injury, increasing with tolerable rapidity up to a certain point, and accompanied by pain which soon subsides. It then becomes stationary as to size, and remains torpid for a variable period, when pain reappears with other signs of inflammation. The presence of the testis is also to be made out by manipulation towards the posterior part of the organ. The surface of the tumor is always smooth, more or less oval or pyriform, and semi-elastic or fluctuating.

The inflammatory affections of the testis have a peculiar shape, being laterally flattened, and are usually accompanied at some period of their course with tenderness and pain, as well as often associated with fluid in the tunica vaginalis. In the syphilitic inflammation, this fluid is often copious. Both organs are also generally involved, either together or at different times. The tumor is usually somewhat tender to the touch and has a firm fibrous feel unlike the semi-elastic and half-fluctuating sensations afforded by cystic or carcinomatous disease. In very chronic cases the testis may, however, be perfectly painless, and allow of any amount of manipulation without distress; the natural testicular sensation also having disappeared. In syphilitic disease, the surface of the tumor will probably be irregular, with firm fibrous outgrowths in different parts and in the tunica albuginea.

In the tubercular affection of the epididymis or testis there should not be any difficulty in the diagnosis, for the tubercular deposit, as a rule, takes place unaccompanied by pain or any symptom beyond that produced by its deposition. When deposited in masses—its usual form—it feels like some foreign body introduced into the substance of the gland or of the epididymis; and is at first quite painless and unproductive of any symptoms, these only appearing when the material begins to soften down and excite some inflammatory action in the parts around. The tubercular material may be deposited in one or more masses, these subsequently, perhaps, coalescing into an irregular induration. When suppuration takes place, the diagnosis is complete.

The cystic or simple tumors of the testis are painless throughout the whole course of their growth, and can be recognized by purely negative symptoms. They attract the patient's observation only from their size, can be handled without exciting pain, and do not usually give even the natural sensation of the organ upon pressure. They are slow in their progress, uniform in their outline, and more or less globular; are always confined to one gland; are rarely accompanied with fluid in the tunica vaginalis; and, on being punctured, emit only a more or less blood-stained glairy mucus.

The cancerous tumors of the organ are more rapid in their development than the cystic, a year's growth, as a rule, giving a large tumor. They are likewise painless, and readily allow of free manipulation. The natural sensation of the organ also soon disappears.

They are accompanied with a hydrocele, and also involve only one organ. They have a more elastic and fluctuating feel than the cystic or the inflammatory enlargements, and when their outline is unequal or bossy, the projection is generally softer than the other portion of the tumor. An exploring needle, or trocar and canula, rarely, if ever, reveals the mucoid fluid so characteristic of the cystic or simple affections, but usually lets out blood or the thin creamy fluid so characteristic of a cancer. In the preceding table, the chief points of difference in the several chronic affection of the testicles are clearly shown. (See Table, p. 664.)

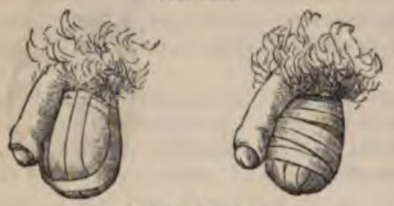
CASTRATION.

The scrotum having been shaven, and the skin over the testicle made tense, a free incision is to be made through the scrotum and tunica vaginalis down to the tunica vaginalis testis, and the body of the organ with its cord exposed; and, when any doubt as to diagnosis exists, an incision should be made into the growth before its removal. A strong silk or carbolized catgut ligature should then be passed through the cord, which must be firmly tied in halves; the cord divided below the ligature, and the tumor turned out of its scrotal covering. There is no necessity to take away any of the scrotum however stretched, unless diseased, since it is sure to contract. All vessels are to be twisted, the wound washed out with some iodine water and dried, and a few sutures put in at the upper part of the wound, the purse being raised when the patient is in bed by a small pillow. No pain is caused when the ligature of the cord has been tightly tied, and about the tenth day it will come away.

To take the vessels of the cord up singly is a troublesome operation and has no advantages. No assistant can hold the cord with his fingers before its division, as it is sure to slip from his grasp.

To strap a testicle requires some skill. The patient should be made to stand against the edge of a table and separate his legs. The surgeon should then with his left hand grasp the organ from behind and press it down to the bottom of the scrotal sac, making the scrotum tense over its surface, the thumb and index-finger of his left hand holding its neck. A piece of elastic strapping spread on leather, half an inch or more wide, is next to be wound round the neck of the tumor once, twice, or even thrice to hold it in position, for if this point be not attended to, all the subsequent steps will be useless. (Fig. 383.)

FIG. 383.



Strapping testicle.

Having done this, pieces of strapping three-quarters of an inch long are to be applied vertically from one side of the circular strip to the other, sufficient force being employed to compress the organ. When the testis is completely covered in and compressed, another circular piece or so should be applied to keep the whole in position, and to bind down the ends of the vertical pieces.

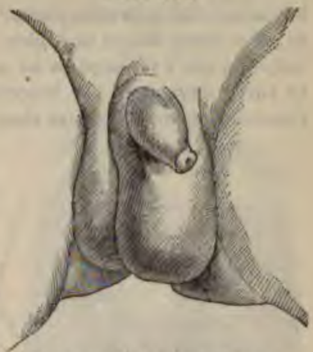
The strapping will probably require reapplication every second day, as the parts soon yield, and the strapping then forms a loose bag. The student must remember that the object of the strapping is to compress the organ, and not to cover it.

Imperfect transition and malposition of the testicle is occasionally met with, the organ being either arrested in some part of its course into its scrotal pouch, or, misplaced. At times one testicle is found in the canal, or it has failed to put in an appearance at all; while at others both are found to be out of place. Not uncommonly, this arrested descent of the testicle is complicated with a congenital hernia, the vaginal process of peritoneum being still open, and in all cases of scrotal swelling in infants, the surgeon should examine the parts with care to discover whether the testicle is or is not involved in the tumor. When the testes are thus placed, they are very commonly ill-developed. At times during their descent through the rings, they are nipped by the muscular structures, and become inflamed. I have recorded such instances in a former page. Nothing can be done by way of treatment to expedite the descent of the organ. When within the internal ring and complicated with hernia, it is well to recommend a truss; but when the testis is in the canal, such an instrument cannot be worn, an extra element of danger, under these circumstances, being added to the case.

Testes so situated seem to be very prone to become the seat of cancerous disease. Many such cases have been recorded.

In a case under my care, of a gentleman over fifty, an encysted hydrocele was found with a small testicle situated in the centre of a congenital hernia, the cyst appearing on the reduction of the hernia as a tumor the size of a small orange, below the external ring and behind the hernia. I tapped it from behind, and drew off about two ounces of a milky fluid containing many spermatozoa, and injected it with iodine. A good result followed. This gentleman was married, and had a family.

FIG. 384.



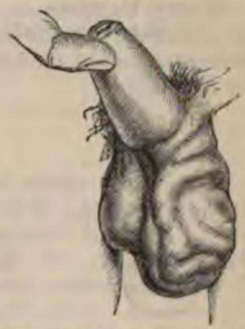
Right testicle in the perineum.

Malplaced testicles are less common than those just described. I have, however, seen seven cases; in three, one of which I have reported ('Guy's Hosp. Reports,' 1867), the right testicle was placed in the perineum in its own independent scrotal pouch (Fig. 384), and in the other four the right testicle was in the perineum, the scrotal sac being otherwise natural. There was in one a hernia associated with the mal-placed testicle; the bowel clearly descending into the tunica vaginalis down to the testicle.

VARICOCELE.

This signifies a varicose condition of the spermatic veins, and when the disease is well marked their tortuosity and dilatations present the appearance (Fig. 385) and impart the feeling of a "bag of worms" within the scrotum. It is more common on the left than on the right side, the assigned causes of this preponderance being the more dependent position of the left organ and the liability of the vein to be pressed upon by a loaded sigmoid flexure of the colon. It is a disease of young adult life, and is doubtless often, although not always, the product of masturbation, or excess of venery. Anything that retards the return of the venous blood from the organ aggravates, if it does not really cause it. The affection is generally accompanied by a dull aching pain in the part as well as a sensation of weight or fulness, but these symptoms are rarely complained of at an early period of the affection. The pain often passes up the groin even to the loins, and is relieved if the patient assume the recumbent position, or even by elevating the scrotum.

FIG. 385.

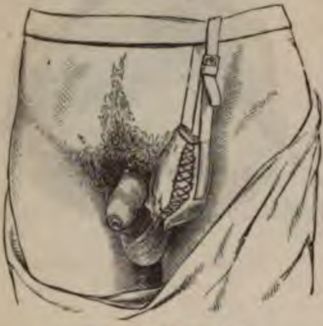


Varicocele taken from case of Mr. Jacobson's.

TREATMENT.—If constipation exists, the bowels must be regulated. If the scrotum be pendulous, cold bathing ought to be recommended, and the organ supported by means of a thin suspensory bandage. Tonics are often of use. When this palliative treatment gives relief and retards the progress of the disease, nothing more is needed; but when the disease is severe and these means are ineffectual, a more radical treatment is called for, which consists in the excision, destruction, or division of the veins.

Excision is a practice which has been reintroduced since antiseptic surgery has become a fashion, and consists of the removal of about an inch of the diseased vein below the external inguinal ring, after the application of a ligature of carbolized catgut above and below the part to be removed. I have seen good results follow this practice, and have known of bad, and regard the operation as far more dangerous than that now to be described. *Operation of Ligature.*—This is now generally done by a subcutaneous operation. Some surgeons employ metallic wire for the purpose, others silken or hempen ligatures, ligaturing the veins in two places an inch apart. I prefer this operation to every other. Mr. Lee uses two pins to arrest the flow of blood, and performs subcutaneous division of the vessels between them; and in my hands this operation has been very successful. Sir B. Brodie used to divide the veins subcutaneously and apply pressure. Mr. J. Wood, of King's, subcutaneously surrounds the veins with a double wire noose, and keeps up pressure upon the wire by means of a metallic spring till division of the veins occurs. Lee's operation is performed as follows: Under chloroform or not, the scrotum on the side of the varicocele is to be taken between the fingers and thumb and the vas deferens (which may always be known by its cordy hardness) allowed to escape, so soon as this is done, a needle may be passed through the scrotum beneath the bundle of spermatic veins, and a figure-of-8 ligature applied over the needle sufficiently tight to arrest the circulation through the veins, but not to cut the skin over them. A second needle is to be applied in like manner, half an inch or more lower down or higher up as the case may be; and the veins divided subcutaneously between the two needles by a tenotomy knife. Sometimes the veins may be divided two or three days after the insertion of the pins, but there is no object in delay. The ends of the needles are to be cut short after the operation, and on the fifth day may be removed. A day or so later the patient may get up, wearing a suspensory bandage. As a general rule, this operation is most successful, and not dangerous. It is only to be done, however, when palliative treatment fails.

Fig. 386.



Morgan's suspender.

Mr. Morgan, of Dublin, has recently suggested an admirable suspender for varicocele and other affections of the testis, which is illustrated in Fig. 386. It consists of a piece of webbing 4½ inches long, 3½ inches wide at one end, 4 inches at the other, and gradually tapering to the narrower end. A piece of thick lead wire is stitched in the rim of the smaller end, two tapes sewn along the entire length of the webbing, and the sides furnished with neat hooks, a lace, and a good tongue of chamois leather. When the suspender has been applied to the testicle, the tapes are to be attached to an abdominal belt. The size may vary more or less. The lead wire encircling the lower end gives a foundation to the general means of support, and keeps the testis within the bag; the patient can mould it more or less to his convenience, and it need not be worn at night.

Fatty tumors are occasionally met with in the cord. I have removed one the size of a walnut; and fibrous or fibro-cellular tumors have been met with on the testicle. I have seen one of the latter the size of an orange, excised from the testicle with success by Mr. Hilton.

Affections of the Scrotum.

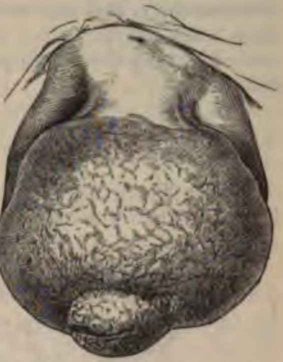
The scrotal pouch is very frequently the seat of injury, while the testicle, from its mobilty, escapes. When the parts are bruised, the effusion of blood is at times very great, the blood forming a large diffused scrotal hæmatocele, while at others, it forms a distinct tumor. On January 29th, 1871, I was consulted by T. B—, æt. 40, who sat down on the broken arm of a chair, the stump of the arm bruising the perineal border of the scrotum. A swelling at once appeared, and when I saw him, twenty-six hours after the accident, a well-defined blood tumor existed in the median line of the scrotum, the size of a cocoa-nut, the two testicles maintaining their position on either side. By rest, cold lotion, and tonics the blood was absorbed in three months.

Lacerated wounds of the scrotum are also attended with blood extravasation, but they usually heal readily on account of the vascularity of the parts.

Œdema of the scrotum takes place whenever any inflammation attacks the part or the tissues about. It is seen in the inflammation of the epididymis associated with gonorrhœa and in acute orchitis; in extravasation of urine and urinary perineal abscess; in the retention of urine in childhood due to the obstruction of a calculus; in phimosis or paraphimosis; in erysipelas. In all these cases it is present, and more or less redness and external signs of inflammation coexist. Simple œdema is often one of the first indications of renal or cardiac dropsy.

Elephantiasis of scrotum.—The scrotum also is not rarely the seat of *elephantiasis arabum*—solid œdema of the scrotum, and the disease generally attacks the penis as well. In tropical countries where this affection is common, the tumors attain an enormous size. It is the same disease as attacks the female genitals and other parts of the body and extremities; and in the West Indies is known as the "Barbadoes leg." By Mr. Dalton, of Guiana, and other observers it is regarded as a constitutional disease. It is occasionally associated with ichthyosis of the tongue, and is often attended with fever and local erythema associated with œdema, which never subsides. When attacking the scrotum nothing but its excision is of any use. The historical case in which Mr. Key removed from a Chinaman, æt. 32, a tumor weighing fifty-six pounds (Prep. 1620*, Guy's Museum), of ten years' growth (Fig. 387), is a good case in point, but the growths attain a larger size than this. Mr. Wiblin, in 1862, excised a growth equally large, and the 'Med.-Chir. Trans.' for 1863, this case with reference to others will be found. uch growths are made up of the elements of ordinary connective tissue. Sir J. Fayrer as operated on many cases. He writes: "The operation r removal of a scrotal tumor is simple enough, but it requires determination and expedition. It needs also the aid f intelligent assistants. Before commencing it is well to ave the tumor raised and supported in a vertical position or half an hour, to drain it of blood as much as possible; hen, the patient having been placed in a recumbent position on an ordinary table, with the nates brought near to the end of it, he is put under the influence of chloroform, and the incisions are to be commenced. Several assistants are required to hold back the legs, raise the penis and testes, support the tumor, and rapidly secure the bleeding points. These being provided, the operation may be begun. The director is to be introduced into the passage at the bottom of which lies the glans penis, and that organ exposed by laying open with either the long catlin or sharp-pointed bistoury the dense tissue covering it. If the prepuce is healthy, it is well to reflect a portion of it as a future covering to the penis. If the prepuce is involved, or even suspected of being involved, it should be carefully dissected away like the rest of the thickened tissue. Having exposed the penis, it is to be raised and carefully dissected out, with or without the prepuce, as the case may be. This is to be raised and held aside by an assistant, care being taken in clearing it out of the morbid tissue not to divide the suspensory ligament.

FIG. 387.



Elephantiasis of the scrotum. (Key's case.)

"The next step is to make a deep and bold incision down to the tunica vaginalis on one side. In a large tumor several incisions will be needed before the tunica vaginalis is exposed, which probably will be found much thickened and distended with fluid, forming large hydroceles. These should be laid open, and if the tunica vaginalis be much thickened it should be removed; if not so affected, and the testicle not enlarged, it need not be interfered with. The testicle is then to be dissected out, reflected, and held upwards with the penis. A similar proceeding is to be carried out on the opposite side. The tumor is then to be removed by connecting transversely the three vertical incisions already made, and then, either with the scalpel or amputating knife, the remaining portion of the neck of the tumor is to be cut through. It is well before separating it to mark out on the perineal aspect by an incision the line at which the removal is to be completed. During the operation, vessels are to be commanded by the fingers of assistants, and large veins controlled by forceps. It is well that even the most minute bleeding point should be ligatured (or twisted), otherwise when reaction occurs there may be hemorrhage. The bleeding having been controlled, the testes with their elongated cords are to be applied to the surface of the wound; the penis is to be enveloped in a fold of oiled lint, and thus kept apart from the testes, which are also covered and supported in position by oiled cloths." The largest tumor of this kind on record weighed 200 lbs.

CANCER OF THE SCROTUM.

This is a rare affection compared with what it was some years ago when sweeps ascended lues, and is commonly met with in this country as a *chimney-sweep's cancer*. It is, owever, well known in the tar and paraffin manufactories of the Continent, the products f distillation of coal, according to Volkmann, being more irritating to the human skin han soot. It is in reality an epithelial cancer similar to that found in other parts of the ody; at times it is very extensive, involving the whole scrotum. Nothing but its emoval can be recommended. Small tumors may be cauterized down or destroyed by austics, but the larger should be excised. When the growth can be isolated by pins assed through its base, the platinum wire écraseur heated by the galvanic battery is robably the best instrument to use, otherwise the knife is to be employed. When the whole scrotum is removed and the testes are left exposed, hanging from their external rings, the surgeon need be under no alarm, for the parts will granulate up in the course of time, and, what is more, the testicles may become movable. I have seen this take place more than once. The earlier the disease is removed the better, for by delay the glands of the groin may become involved.

The scrotum is occasionally though rarely the seat of tumors, sebaceous, fatty or fibrous. It is, likewise, the seat of varicose veins; the small venous radicles appearing as beaded dilatations of a peculiar aspect; the disease is, however, of little importance.

Tumors or swellings that encroach upon the scrotum from the perineum are probably inflammatory, and are most frequently urinary abscesses associated with and dependent upon some stricture; but occasionally an anal abscess may press forward, and I have seen one occupying the whole perineum up to the scrotum. These are to be treated by free incisions.

STERILITY.—MALE IMPOTENCE AND SPERMATORRHŒA.

The influence of the sexual functions is so great in the economy of human life, that any impairment of the organs concerned is a matter of importance, not only in its effects on the bodily health, but even more on the mental state of the person affected.

The sexual act is a compound one, physical and mental. The physical organs may be perfect and capable in their way, but if the mental are deficient in energy or weakened by doubt of competency, or under the influence of some emotion such as shame or fear, the act will be spoilt, and failure to complete it must ensue.

It is, therefore, clear that impotence, real or imaginary, may be due to many physical and mental causes.

Taylor defines *impotency* "to be an incapacity for sexual intercourse." The incapacity may ensue from physical causes, remediable or irremediable. The latter includes loss of penis and testicles, deformity of penis, including excess of and arrest of development, mal-development, in such cases as ectopia vesicæ, &c. The remediable causes may be some local affection of the penis or testes.

Any condition that prevents the introduction of the organ into the female passage is enough to cause impotence, whether such condition be connected with the penis or testes. The same effect is produced by any disease or congenital malposition or development of the testes, attended with loss of sexual desire, as by old age. A man may, therefore, be impotent and virile, or impotent and sterile.

A man may be capable of sexual intercourse and yet be sterile; sterility in the male depending much upon the secretion of the testes, as well as upon the formation of the penis, for semen without spermatozoa is destitute of procreative power. A man may have a penis the subject of epispadias or hypospadias; he may have sexual desire, and even power, but if the urethral orifice be so low down as to forbid the semen being conveyed into the vagina, he will be sterile; though all patients with hypospadias are not so. I have known two men who had hypospadias—the orifice of the urethra in each, opening one inch behind the normal urethral opening—to be the fathers of three and four children respectively; and a third, in which the urethral orifice was one inch behind the glans, whose wife died in childbirth.

When the urethral orifice is at the base of the penis, sterility must, however, exist. When partial epispadias exists, there is no reason to believe that a man must be sterile.

When both testes are misplaced—that is, when they have not descended into the scrotum—there is a strong probability that the organs are badly developed, that they do not secrete healthy spermatic fluid, and that sterility coexists. Curling asserts this very positively to be the fact, but he at the same time brings forward evidence from Messrs. Cock's and Poland's practice that such is not always the case. In a general way Mr. Curling may be right, but there are many exceptions to such a rule. When one testis is in the scrotum and healthy, there is no reason to suspect sterility.

Sterility sometimes follows disease of the testes, inflammatory or otherwise; for epididymitis or inflammation of the duct of the gland may be followed by atrophy of the organ. Gosselin, Godart, and Liegois have laid great stress upon this; and Curling ascribes these as common causes of sterility. Sterility may be produced by involuntary seminal emissions the result of excess of venery or masturbation, by producing either loss of sexual power or deterioration of semen. Stricture, or any impediment to the seminal discharge, is also another cause. The student must remember, too, that a man may be capable of sexual intercourse and be sterile from other causes. He may even have emissions in connection without seminal secretion, for the emissions may consist only of secretion from the seminal vesicles. I have known this fact illustrated in a man who had lost both his testicles from a surgical operation, and yet had sexual power as strong as ever, attended with emission. The removal of one testicle seems to interfere but little if at all with sexual power. Some years ago, I removed a testicle for cystic disease from a gentleman who had been married many years and had no child. After the operation his wife soon conceived and gave birth to a boy.

In the *female* subject, impotency may be said to exist when the vagina is absent or obliterated. It is for a time present when the orifice is occluded by some dense membrane, or when the introduction of the male organ is prevented on account of the smallness of the orifice, by vaginismus, or the presence of a bifid vagina.

Sterility is due to many causes, the occlusion of the os uteri being one, but morbid conditions of the uterus and ovaries are probably the more frequent.

The student should remember, that "the functions of the testicle, like those of the mammary gland and uterus, may be suspended for a long period, possibly for life; and yet its structure may be sound and capable of being roused into activity" on any healthy stimulus. Unlike other glands, it does not waste or atrophy for want of use, the physical parts of man's nature being accurately adapted to the necessities of his position, and to his moral being.

SPERMATORRHŒA.

This doubtless exists as a disease although rare. It consists in the discharge of spermatic fluid containing spermatozoa with the urine, without sexual desire or sexual excitement. It is commonly associated with some derangement of the digestive organs, constipation, and rectal irritation, spasmodic action of the levator ani acting on the vesiculæ seminales and prostate gland. In its most complete form it is associated with an absolute loss of sensation about the veru montanum on the passage of a sound, a patient thus affected allowing the introduction of an instrument without flinching; while the worst cases are associated with wasting of the testicle and varicocele. It is at times without doubt due to excess of venery, but more commonly to masturbation. It commences almost always with nocturnal emissions which gradually become more frequent. These are at first attended with erotic sensation, although not so subsequently, and at last occur without erection. If copulation be attempted, the ejaculation takes place at once, often before the introduction of the organ. It ends in the total loss of sexual inclination and power. Lallemand says that "seminal emissions supervening during micturition are the most serious."

He holds that "spermatorrhœa is nearly always dependent upon irritation of the prostate gland and its ejaculatory ducts," and believes that in most cases this irritation, which also exists in the neck of the bladder, is the result of chronic inflammation of the urethra in the prostatic portion of the veru montanum. An old attack of urethritis is the most frequent cause of the seminal emissions, and these emissions are often related to stricture of the urethra.

Trousseau, however, while admitting the force of these observations, believes that spermatorrhœa or incontinence of semen is due to some imperfection in the nervous system of organic life, since it is so commonly found in men who have had incontinence of urine in childhood. He looks upon the masturbation as an indirect proof that there is a bad state of the nervous system, and the subsequent impotence, insanity, or paralysis as an aggravation of a nervous condition, of which masturbation was only the first morbid manifestation. (Trousseau, 'Clin. Med.' vol. iii.) This latter view is supported by the fact that in some cases of injury to or disease of the spinal column, spermatorrhœa is a common associate.

False spermatorrhœa is, however, a more common complaint. It is supposed to be present when nocturnal emissions are frequent, when diurnal emissions take place on any sexual thought, and urethral discharge of a glairy fluid attends defecation, when erections with discharge follow the slightest irritation, such as that produced by riding or walking, from the friction of trousers, etc. Such cases are far from rare; and are commonly due to masturbation, but are not cases of true spermatorrhœa, although they often precede it. Nocturnal emissions may be too frequent, but, if associated with sexual feeling, they are natural. They should, therefore, be checked, as they lead on to the true disease. The glairy fluid pressed out in defecation is rarely seminal; but is prostatic, of a transparent, tenacious character, and not milky. The whole genital tract in this affection is in a state of morbid sensibility, of hyperæsthesia, and requires treatment, since the false spermatorrhœa is often only the prelude to the true.

TREATMENT.—Trousseau, regarding masturbation as a manifestation of some disease of the nervous centres, speaks strongly in favor of belladonna, and, so far as my experience has gone, I am disposed to think it a valuable drug given in half-grain doses of the extract twice a day with some tonic, such as iron, zinc, strychnine, or quinine. It seems to act most beneficially, and to check the disposition to masturbate in a marked manner. Of course, this good can only be met with when there is in the patient's mind a strong wish to overcome a repugnant habit. To aid this, the application of a ring of blistering fluid around the penis, or painting the prepuce with iodine, is a valuable adjunct. The bowels, more particularly the rectum, under all circumstances should be kept empty, and the nightly injection of cold water into the bowel is a useful custom. The patient should sleep upon a hard bed, and be lightly covered. He should not rest on his back, and a solid substance fastened in a handkerchief over the sacrum is a good mode of securing this end.

When evidence exists that the mucous membrane of the prostatic urethra is affected near the orifices of the spermatic ducts, Lallemand's advice of applying a solution of nitrate of silver (gr. v to gr. x to the ounce) every other day should be followed. Some surgeons use a stronger solution, and when an absolute loss of sensibility of these parts is present, galvanism has been highly spoken of. For the application of the solution, Erichsen's syringe catheter is the best. Every means should be employed to divert the patient's mind from the seat of his affection by encouraging mental as well as physical labor. Simple nutritious food should be allowed and cold bathing adopted.

In the cases of imaginary impotence of young married men, all that the surgeon has to do is to give confidence, for the failure is probably in the mind rather than in the body of his patient. The best advice is, to recommend abstention from coitus, when Nature in her own time will have her way and assert her power.

CHAPTER XXV.

SURGICAL AFFECTIONS OF FEMALE GENITALS.

Wounds of the external genitals are met with in practice, as the result of violence intentionally committed, or happening accidentally from falling or sitting on pointed or cutting bodies. They are always serious on account of the bleeding that attends them. and wounds of the vagina are particularly so. However severe they are, they should be carefully cleansed, adjusted, and stitched together, for these tissues are very vascular and heal well.

Severe lacerations at times take place in the attempt at coitus. Some years ago, I was called to a young married woman for severe hemorrhage from these parts following marital intercourse the night after marriage, and found two severe lacerations of the orifice of the vagina and hymen unruptured; the membrane had been practically driven in. Pressure arrested the bleeding.

Wounds of the vagina are apt to be followed by inconvenient cicatrices.

Foreign bodies are also at times introduced into the vagina for criminal or erotic purposes. Mr. Hilton removed at Guy's a flat bone netting mesh, ten inches long, which had passed through the vaginal walls into the pelvis. Bottles and other foreign matters have also been introduced. Sponges are not uncommonly found in the passage, and in a case I knew of, such a foreign body gave rise to the suspicions of cancerous disease.

ADHERENT LABIA.

The labia during childhood are apt to adhere together from some local inflammatory action, and so to close the labial orifice as to interfere with the act of micturition. The urine in children thus affected, often squirts in a backward or forward direction, and for this, surgical attention is sought. In these cases, the true condition of affairs will at once be recognized on separating the genitals, for the labia will be found connected together by a membranous adhesion which passes forwards in some cases to the urethral orifice, thereby affecting the urinary stream. This membrane is readily broken down by separating the labia with the fingers or thumbs, or by means of a probe introduced behind it from above. The application of a little cold cream will complete the cure if care be taken to keep the parts clean.

VULVITIS.

This is a common complaint in children, and is almost always due to some rectal irritation such as that caused by worms, scybala, &c., in the feeble and badly fed. It is rarely the result of a gonorrhœal affection, as is too often suspected, and it is well to be aware of this fact, as it is not uncommon for a surgeon to be consulted about a child with vulvitis under the suspicion that the affection is the result of an impure criminal contact, when it is due to some simple non-venereal cause.

It should be treated by local cleanliness and mild astringent lotions, such as lead, alum, &c.; when worms are suspected, by the administration of a good mercurial or jalap purge, and attention to the digestive organs and general health; a mixture of rhubarb and soda for a few days, and subsequently a tonic generally effects a cure.

Noma, or phagedænic ulceration of the labia, similar to the cancrum oris after the exanthemata, is met with in cachectic children, and is a disease of debility. It commences as an inflammatory swelling of the parts similar to erysipelas, passing on to gangrene and ulceration, and is always attended with great prostration. For its treatment such tonics as can be borne should be given; and particularly iron, quinine, or bark. Wine and abundance of good liquid nourishment should be given by the mouth, or, by the rectum when the stomach rejects it, and milk with chlorate of potash is a good drink. Locally, opium lotion with carbolic acid, nitric acid, or nitrate of silver should be used, and when the ulceration spreads, nitric acid in its concentrated form may be applied or the actual or galvanic cautery.

Nævi, when found involving these parts, are to be treated like others.

Hernia.—In women, the labium may be the seat of an inguinal *hernia* or of a *varicocele.* The former is known by its own symptoms, the latter by its wormy feel. It may also become the seat of *thrombus* or blood tumor on the receipt of an injury, which is to be made out by the history of the case, the sudden appearance of the swelling after an injury, its external aspect and fluctuating feel. Such blood swellings are to be treated at first by the local application of cold to arrest the flow of blood, and, subsequently, by lead lotions. If they tend to break up and form an abscess, a free incision into the swelling is the right treatment to adopt.

Labial abscesses form at times as a result of a softened thrombus, but more frequently from follicular inflammation. They are very painful and ought to be opened early. Occasionally they are the consequence of an inflamed cyst.

Labial cysts are very common, and are usually met with on the inner side of the labia. They are similar in their nature to the mucous cysts found in the mouth or about the tongue, and are formed in the same way by the obstruction of the ducts of the mucous glands of the parts. They appear as chronic painless swellings producing only mechanical inconvenience; but if neglected, they may inflame and suppurate. On manipulation, they feel tense, globular, and semifluctuating, and contain a glairy brown or blood-stained fluid, at times with cholesterine. They are to be treated by excision, or the removal of the presenting surface of the cyst by a pair of forceps and scissors, the removal of one wall exposing the other, which contracts. Excision, however, is the safest practice. When an opening into the cyst is made, the cavity should be plugged with lint, or with lint soaked in tincture of iodine—this fluid exciting adhesive action or suppuration in the cyst wall.

Mucous cysts, like these, are also found in the vagina.

The internal labia may also be the seat of *sebaceous tumors*, and of a solid œdema or hypertrophy similar to that seen in the male scrotum not unlike *elephantiasis*, and grow to a large size. Nothing but their removal can be entertained. Some time since I removed with the galvanic écraseur, from a middle-aged woman, both labia which had attained the size of a cocoa-nut without the loss of a drop of blood, after having isolated the growths by long pins inserted through their bases, and passed the wire round the pins. When this instrument cannot be obtained, the knife must be employed. Such tumors are highly vascular, and the surgeon requires good assistants in their removal.

Cancerous tumors, both epithelial and otherwise, of these parts are also met with, and are known by their ordinary features; they should be treated by removal. It seems that cancer is prone to appear in these regions at an earlier period of life than in others. In 1869 I removed a well-marked cancerous tumor from the labium of a woman only thirty-two years of age.

Epithelial disease of the clitoris occurs at times, and I have seen several well-marked cases, but more commonly it attacks the inner labia and orifice of the vagina. In such cases the benefit of the galvanic cautery is well illustrated, for the removal of these growths by excision is very difficult, and always attended with copious bleeding. When the whole growth cannot be isolated, as much as possible should be excised or scraped off, and the cautery freely applied to the surface and base of what remains. Where the growth can be isolated by the introduction of long pins beneath its base and a wire adjusted beneath the pins the galvanic écraseur, not made too hot and slowly worked, is an admirable instrument to employ. By its means I have successfully removed on several occasions without the loss of a drop of blood an epithelial cancer occupying the fourchette of the vagina, encroaching on the passage and the perineum. The patients were under chloroform during the operation and felt no pain; the after-pain in these cases being always slight, the cautery entirely destroying the sensibility of the divided parts. Wounds so made heal kindly.

Lupus also attacks these parts like others; while *warty growths* are common.

Syphilis has received attention in another page.

Imperforate hymen is a condition to be recognized and not confused with the adherent labia already referred to. The hymen is more deeply placed nearer the orifice of the vagina. When imperforate, it causes retention of the menses, the accumulation of the secretions, and a pelvic tumor usually accompanied by periodic pain and constitutional disturbance.

The proper treatment of these cases is the division of the imperforate membrane or its complete excision, the object being to allow of the free escape of the retained secretion, which is usually black and treacle-like. Success usually attends this practice, though a fatal peritonitis at times ensues.

A rigid hymen is occasionally an impediment to coitus in women who marry late in life, and I have known one in which for two years after marriage the husband had never had perfect connection on this account; indeed, it was not till after his wife had become pregnant, and the vaginal membrane had been ruptured during the birth of the child, that a satisfactory coitus was effected.

I have also been called upon on one occasion to divide the hymen of a lady about thirty, who had been married for some months, and had never had complete connection, the husband's penis having been very large.

There are cases on record showing that, when a vagina is occluded and the patient been married, the urethra has been so enlarged as to admit the finger, and in all probability the male organ.

A double vagina is another cause of difficult coitus. I was consulted in such a case by a patient who had been married for several years, and never had connection. The woman came to me, as a divorce was under consideration. She complained of extreme pain whenever an attempt at coitus was made, and the husband of inability to penetrate. On making a careful examination, a double vagina and uterus were discovered. I advised the division of the septum with the galvanic wire, by perforating the septum near the uterus and gradually dividing it by means of steady traction upon the wire; but, whilst the question was under the consideration of both parties, the suspicion of pregnancy occurred, and time proved its truth. A child was born prematurely after a tedious labor, and I heard no more of the difficulties of the case. She became pregnant a second time.

Besides these deformities, others may occur, such as occlusion of the vagina or absence of the uterus, or the opening of the rectum into the vagina, &c. &c.

The *clitoris* is occasionally enlarged at birth, appearing as a small penis. I have seen an example of this, and at the end of the clitoris a depression existed corresponding to the male urethra. The child in other respects was natural. This organ, however, may in after life become the subject of hypertrophy, indeed, of a kind of elephas as of the male penis, and require removal.

Clitoridectomy for epithelial cancer has already been alluded to. This operation has been practised for epilepsy and supposed erotic complaints, but evidence is wanting to justify the step. The operation for such purposes appears at present to be unjustifiable.

Vaginal tumors, besides the cystic and epithelial, are occasionally met with, and vaginal polypi are found. I removed one the size of a nut from a child three years old, and similar cases are on record. They should always be ligatured and excised.

RUPTURE OF THE PERINEUM.

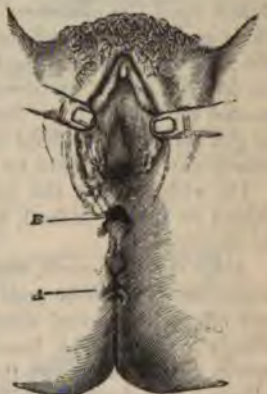
This accident is not rare as a result of a rapid delivery, and to a small extent it is somewhat common in first labors.

When limited, it is not of much importance; but when extensive, the pelvic organs lose their natural support and are liable to fall, giving rise to *rectocele* or prolapse of the posterior wall of the vagina, or, *cystocele* or prolapse of the anterior wall of the vagina.

When the sphincter ani or rectum is implicated, the accident becomes of grave importance.

At times the rupture is central, and, in the case from which Fig. 388 was taken, the child was born through the rupture B. The incident took place in the practice of a medical friend, who sent the case to me. Dr. Wilson witnessed a like process in a similar case ('Ed. Med. Journ.,' April, 1875).

FIG. 388.



Central rupture of the perineum through which child was born.

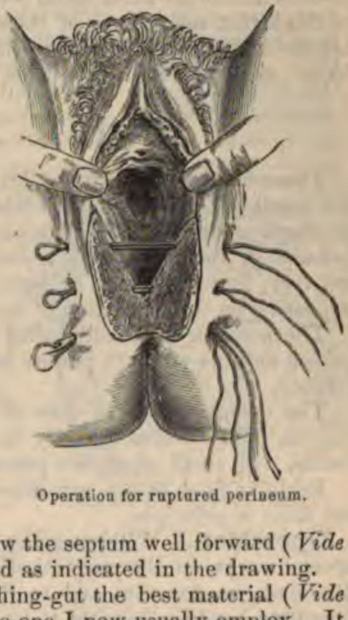
There is no reason to believe that such an accident is in all cases the fault of the accoucheur, although, doubtless, it is so with some; yet, with a large child and rapid labor, it is often difficult to prevent. I have known it occur in the practice of very good men.

Slight ruptures of the perineum need not be regarded, but when a rupture into the body of the perineum takes place during labor, and the accident is recognized, the best practice is to put in one or more sutures at once. This practice is so sound that it cannot be too confidently recommended.

When the operation is not performed at once, but postponed to the future, it must be left till the period of suckling has passed and the general health of the patient been restored, as the operation, being a plastic one, requires good power on the part of the patient, and immediate union of the wound is wanted for success. It is very successful when properly performed; indeed, it rarely fails.

Operation.—The bowels should be well cleared out by an aperient given two days before, and an enema on the day of operation. Chloroform should be given, the patient placed in the position for lithotomy, with the buttocks brought to the edge of the table, and Clover's crutch applied to keep the knees apart. An assistant should then well separate the labia, and the surgeon with his scalpel map out the portion of integument that he proposes to remove, remembering that it is well to have a broad surface to bring together as well as a cleanly cut one, for a thin membranous union is useless, and a jagged surface will not unite. At least an inch of raw surface should be made from the recto-vaginal septum forward, the width of the bared surface diminishing slightly towards the anterior portion of the labia. Having thus mapped the parts out for removal, the best plan is to perforate the tissues towards their centre and then cut outwards, the right half being first treated and then the left (Fig. 389). Not a remnant of the mucous membrane should be left.

FIG. 389.



Operation for ruptured perineum.

If bleeding follows, the larger arteries may be twisted while a little pressure soon controls the smaller.

The *second* step of the operation, or the introduction of the sutures, remains to be performed, and it is of no less importance than the first. The sutures should be introduced when the quill is used, at least an inch from the margin of the wound, and when gut alone is employed, a quarter of an inch, the one nearest the rectum being first inserted. When the recto-vaginal septum is involved, the introduction of this suture is of primary importance. It should be passed deeply through the left side of the wound rather behind the level of the septum, through the tissues and the septum, and out at a corresponding point on the right side, being completely buried in its whole course, the object being to draw the septum well forward (*Vide* Fig. 389). A second and a third may then be introduced as indicated in the drawing.

A quill suture is probably the best to use, and good fishing-gut the best material (*Vide* Fig. 37). A needle, such as that seen in Fig. 389, is the one I now usually employ. It is curved on the flat so as not to cut the recto-vaginal septum in its passage, and has an eye in its point to admit the double suture. The parts should be pressed together firmly after their apposition, and several superficial sutures of silk or gut may be introduced. If there be much spasm of the sphincter, a division of the superficial fibres of the muscle at its posterior margin or two lateral notches may be made. I have done this only in exceptional cases.

After the operation is completed, the fingers should be introduced into the vagina and rectum to assure the operator that the parts are in apposition, and, when any blood has passed into the vagina, the passage should be syringed. A morphia suppository may then be placed in the rectum to relieve pain and spasm, and to lock up the bowels.

The patient ought then to be removed to bed and the legs should be tied together, and flexed upon the abdomen. The urine should be drawn off every six hours for the first three or four days, and the parts kept clean. Iced milk and beef tea should be given for the first day, but meat and wine subsequently if the appetite allow. The patient may lie on one side when preferred. If the quill suture is used, the deep sutures should be removed on the third or fourth day, and the superficial on the seventh. When silk, wire, or gut sutures have been employed, they may be left for six or seven days; but after the fourth day they should be taken away when suppuration appears in their track.

On withdrawing the quill sutures, great care should be observed not to separate the thighs or parts; indeed, for quite ten days or more after the operation this point should be observed.

After the first week, the use of the catheter may be dispensed with, the patient making water on her hands and knees, the parts subsequently being carefully sponged. When any offensive vaginal discharge appears, the passage may be syringed with a lotion of Condy's fluid. The bowels should be locked up for at least a week by small doses of opium twice a day, and then relieved by a dose of castor oil after some warm oil has been injected into the bowel; but, in some cases where union is thought to be feeble, it is well to keep them from acting for a longer period, care being always observed that no large indurated motion be allowed to pass, warm water and oily enemata being used.

With this attention, good success generally follows, and women may have subsequent labors without any giving way of the parts. Where much prolapse of the posterior wall of the vagina coexists, a strip of mucous membrane running up the vagina from the anal end of the recto-vaginal septum may be cut off, and the edges of the wound brought together. I have done this in many cases with an excellent result; indeed, in many cases of prolapse of the uterus, following some slight rupture of the perineum or even without, this operation is of great value.

In vaginal cystocele, a like operation is of benefit, the removal of a piece of vaginal mucous membrane at its labial border being often followed by a good result. I am tempted to think that many more of these cases of vaginal and uterine prolapse can be greatly benefited by surgical treatment than the majority of practitioners believe; and that in the future, surgical treatment will be more frequently demanded for these affections.

VESICO- AND RECTO-VAGINAL FISTULÆ.

Abnormal communications between the bladder or rectum and the vagina are usually the result of long and tedious labor from sloughing of the tissues after too much pressure, although at times they may be caused by the rough use of instruments, the retention of a pessary, or the presence of a stone. They are, usually, discovered a few days after the delivery, by urine, wind, or feces passing through the vaginal passage, these symptoms appearing on the separation of the slough.

The surgeon is usually called upon to treat the case when the puerperal month has passed and the patient's powers been restored; till then it would be rash to think of interference.

The operation for the cure of these affections is a very good one, and generally successful, failure following only in exceptional instances, that is, when the subjects are feeble, with small reparative power, or when the loss of tissues is too great to be made up.

Recto-vaginal fistulæ are more readily cured than vesico-vaginal, but both operations are alike in principle.

Operation.—Without going into its history, full details of which can be found in the special works on the surgical diseases of women, it may be said, that it is to Sims and Bozeman, in America, and to Simpson and Brown, in this country, that the modern operation has been brought to its present state of perfection, although it is probably due to the introduction of chloroform that its great success is to be attributed.

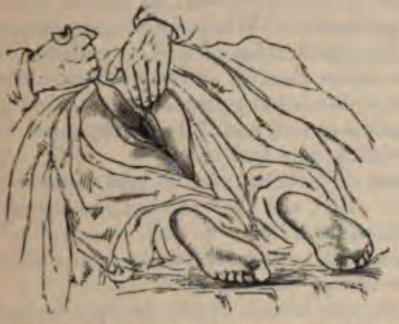
Very small fistulæ may probably be cured by the actual or galvanic cautery, but every ning above the size of a crow-quill demands some plastic operation.

In the operation, the surgeon has three main points to observe:—1st. To bring the ula well into view and under control; 2d, to pare with nicety and accuracy its whole rgin; and 3d, to bring into and maintain in apposition, the raw and incised surfaces.

For the first object the duck-bill speculum is undoubtedly the best; by some authors it spoken of as Bozeman's, by others as Sims's. It is both a dilator of the vagina and a tractor. Some surgeons, Jobert being amongst them, talk of exposing the fistula by agging the uterus externally, and thus everting the vagina. I have never had the ldness to use sufficient force to do this, and cannot advise it. Such a measure would, wever, greatly facilitate the different steps of the operation.

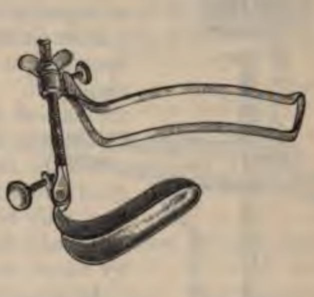
Weiss has recently so arranged the duck-bill speculum as to be self-supporting (Fig. 1). I have used the instrument and have been much struck with its value.

Fig. 390.



Position of patient for vesico-vaginal fistula.

Fig. 391.



Self-retaining vaginal speculum.

For recto-vaginal fistula the patient should be placed on her back, as in lithotomy, and vesico-vaginal fistula this position is at times the most convenient; though I usually fer the semi-prone position, the knees and thighs falling over the end of the table, the geon looking down upon the fistula (Fig. 390). When the rus is dragged down sufficiently far to evert the fistula, the otomy position is doubtless to be preferred.

The fistula having been brought well into view, the next step o pare its edges, and in doing this the operator must not be sparing of tissue; his aim being to obtain as broad and as an a surface as he can. When this can be secured by means a knife and forceps, no better instruments are required, the t knife being one that can be adjusted to any gle with rapidity and ease. When the fistula is h up in the vagina or large, the pronged guide modification of Hilliard's, of Glasgow) made for many years ago is an excellent instrument (Fig. 2). It is readily applied and insures a clean cut face. Some surgeons prefer the scissors (Fig. 2A).

Fig. 392.

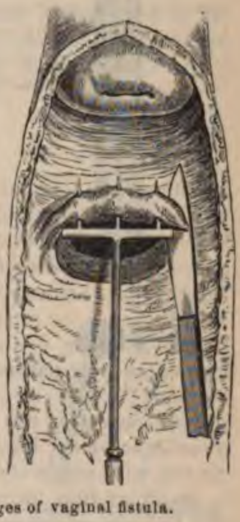
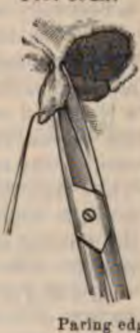


Fig. 392A.



Paring edges of vaginal fistula.

When this step of the operation has been comted, the edges of the fistula must be brought ether, and for this purpose numerous devices e been employed. Splints of all kinds have n suggested, but with experience they have all n discarded, simple wire, silkworm-gut, or silk ures, fastened with shot or otherwise, being pre-red. I have tried every form of splint, and e at last come to gut sutures with or without shot fastenings, using occasionally a ited fishing silk.

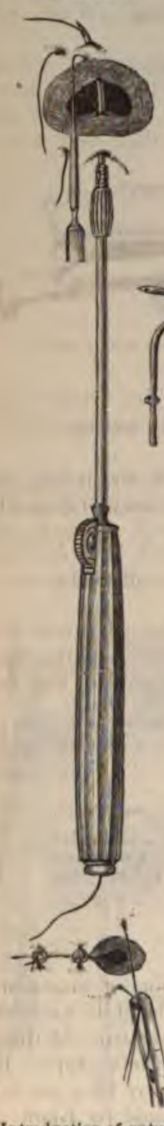
The sutures should be introduced tolerably close together, and at a good distance from margin of the wound, say a third of an inch, and should not be drawn too tight. ey should be fastened by running a perforated shot down over them, taking the precaution subsequently to tie the gut over the shot to prevent its giving way. In this step, the operation is similar to that for fissured palate. In Fig. 393 the needles employed with the mode of introducing and securing the sutures may be seen.

A good strong pair of forceps is required to nip the shot after they have been slipped into position.

When wire or gut is employed, Startin's hollow needles may be used, but the ordinary curved needles with good eyes at their ends are the best for silk. With wire, gut, or silk the shot fastenings are the best.

After the operation, the vagina should be well cleansed of blood and the bladder emptied. Ice or iced water will generally arrest any bleeding that may ensue. An opiate suppository should be administered after the operation to give ease, and the same practice should be followed with respect to the bladder and diet as has been recommended after the operation for ruptured perineum.

FIG. 393.



Introduction of sutures in vaginal fistula.

To leave a catheter in the bladder after the operation for vesico-vaginal fistula often adds to the irritation; its careful introduction at stated periods being preferable. When from circumstances this cannot be attended to, the introduction of a short catheter, with an open end to allow of the urine passing as it is secreted, should be employed. Dr. Meadows allows his patients to pass their urine in the natural way after the operation, and I have dispensed with the catheter in some cases without any bad result.

On the sixth or seventh day, the sutures may be removed; but if good union has not taken place, and they are not causing irritation, they may be left in position for a longer period.

During the convalescence, the vagina should be kept well cleansed by water, or a lotion containing Condy's fluid.

In recto-vaginal fistula, the bowels should be kept locked up for ten days or a fortnight till the wound has firmly united, and then the feces should be rendered soft by enemata of oil and gruel.

When the tissues around the edges of the fistula are too thin to allow of their being pared, and, indeed, under some other circumstances, they may be split; that is, the vaginal mucous membrane may be raised from its submucous bed for half or three-quarters of an inch round the fistula, and the under surfaces of the raised membrane brought together and held there by a quill suture. I have adopted this method on many occasions, and been most favorably impressed with its advantages. I was led to do so some years ago in a case of vesico-vaginal fistula where there was no tissue to spare, and was pleased subsequently to see so good a surgeon as the late Mr. Collis, of Dublin, make the same suggestion. When this plan is adopted, the sutures must be removed on the fourth day, otherwise the pressure of the bougie may cause ulceration. At times it is best only to cut the sutures, and leave the quills in position for a day or so longer—the amount of irritation they cause being the surgeon's guide. Dr. Kidd and Mr. Mapother, of Dublin, have adopted however what appears to be a better practice. They make a U-shaped cut round the fistula through the mucous membrane of the vagina, raise the flap thus formed and cut off its lower half, including the opening of the fistula in the vaginal mucous membrane. They then draw down the shortened flap over the fistulous opening into the bladder, and unite it by sutures to the crescentic border of the mucous membrane forming the bed from which the flap had been raised. The fistulous opening into the bladder is thus covered over with a flap of sound mucous membrane. ('Brit. Med. Journ.,' June, 1872.)

When the neck of the uterus is involved in the fistula, it may be necessary to lay it open; but, when the uterus is involved, it is more frequently necessary to turn the neck of the uterus into the bladder and close the vagina high up. In very extensive lacerations of the vesico-vaginal septum, the surgeon may be called upon to close the vagina nearer its orifice. I have done so on several occasions with good success, two or more operations being required.

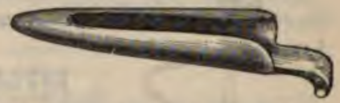
When the fistula is surrounded by cicatricial tissue, and when after the adaptation of its edges there is much tension, lateral incisions through the parts are of great use; as they allow the edges to come together more readily, and thus facilitate repair.

In recto-vaginal fistula unconnected with parturition, before an operation is attempted, the surgeon should satisfy himself by a digital examination of the rectum that no stricture or disease of the rectum coexists to which the fistula is secondary.

Vascular excrescences are very common in the female urethra, and from their great sensibility cause severe pain. They at times project from the meatus as a florid outgrowth, are often attended with a discharge of mucus, and at times of blood, also with irritability of the bladder. Their removal is the only sound treatment, which can be effected by forceps and scissors, or by means of the galvanic cautery. When the former practice is followed, the growth should be well drawn downwards and excised, a stick of nitrate of silver being applied to the base of the tumor to prevent bleeding. When any doubt exists as to its complete removal, chloride of zinc may be used

When the urethra is the seat of more than one such growth, the introduction of a stick of sulphate of zinc at intervals of two or three days may be followed by the withering of the growths; but when this result does not ensue, the passage must be dilated and the growths removed. Nitric acid in some cases is a good caustic to insure their destruction when excision or the galvanic cautery cannot be employed, and Dr. A. Edis has recently ('Brit. Med. Journ.,' April 4th, 1874) used with advantage the saturated solution of chromic acid, applied by means of cotton wool rolled round a stick to the growth until the surface became shrivelled.

FIG. 394.



Speculum dilator for female urethra.

To facilitate the use of any of these means, but more particularly the destruction of the growth with the galvanic cautery, I have found the use of the box-wood or ivory speculum and dilator depicted in Fig. 394 of great use. The urethra can be readily dilated by it, the growth made to project through the aperture left in its side, and the whole destroyed without doing any injury to the healthy tissues.

Polypi of the female bladder may protrude through the urethra, and put on the appearance of a urethral growth; but a complete examination of the urinary organs will prevent the surgeon falling into any error of treatment.

Fibro-cellular tumors at times grow in the urethra and cause much local distress. I removed one from a lady some years ago, with a good result, which occupied the whole floor of the urethra to the neck of the bladder.

Irritable-bladder in women is a very common effect of uterine disturbance or displacement, as well as of rectal disease. Such a symptom demands the closest investigation to ascertain its cause. It is mostly secondary to disease of the uterus, &c., and not often dependent on bladder affections.

CHAPTER XXVI.

DISEASES AND TUMORS OF THE BREAST.

Sore nipples are sources of great distress and too often the precursors of mammary abscess. They are doubtless often caused by some aphthous condition of the child's mouth, but as frequently result from some unusual sensibility of the skin of the part, and at times from want of care. In first pregnancies mothers should always harden their nipples by the daily use of some spirit lotion, or eau de Cologne and water; and, where they are not sufficiently prominent, a breast glass or gutta-percha shield, such as that sold by Elam, of Oxford Street, should be worn, as nothing tends more than these means to prevent this troublesome affection.

When sore nipples occur at the time of suckling, the same shields should be worn, great care being taken to dry the nipples after use, and never to leave them in the child's mouth after the process has been completed. The application of the glycerine of tannic acid, Richardson's styptic colloid, tincture of catechu, a solution of nitrate of silver, gr. v to the ounce of water, or an ointment of extract of rhatany, gr. viiij to ℥ij to the oil of theobroma, are good applications. Castor oil as an external application, or collodion, is sometimes useful. When cracks exist, it is a good plan for the mother to draw out the nipple by means of the old-fashioned feeding bottle before giving it to the infant, the mother's nipple being put into the central opening, and her mouth drawing the artificial one. Another ready method is the application to the nipple of the mouth of a wide-necked empty bottle that has been heated by hot water, the nipple, as the bottle cools, being pressed into the bottle and rendered prominent in a painless way.

Engorgement of the breast takes place, when, from any cause, a woman is unable to give such, either from defect or disease of the nipple or the death of the child. Under these circumstances, the glands may become tense and distended, and, if left unrelieved for twenty-four or thirty-six hours, will probably inflame. When the glands, however, can be relieved by the application of an infant to the nipple, or next best by a bottle in which a partial vacuum has been made by means of hot water, the mother's mouth, or a *very carefully* applied breast pump, the engorgement may subside and no harm accrue.

Pressure should then be employed by means of strapping, which must be applied over the gland previously smeared with the extract of belladonna, rendered liquid with an equal part of glycerine. A saline or other purge is often of value, with some tonic medicine as quinine—a mixture of two or three drachms of the sulphate of magnesia and one or two grains of quinine, two or three times a day being as good as any.

In lobular engorgement of the breast, gentle friction is of great value, with or without oil, and warm and moist applications are also most useful.

INFLAMMATION OF THE BREAST.

This may occur as a *subcutaneous* more or less extensive peri-glandular abscess; a *local* phlegmonous lobular inflammation; or a *diffused* abscess throughout the whole gland; and may primarily involve the connective tissue which exists between the lobules as well as the true secreting structure of the gland. It may likewise occur behind the gland.

It may be *acute* or *chronic* in its nature; it may run its course without any breaking up of tissue or suppuration, or be attended with most destructive local results; the extent of destruction of tissue depending upon the severity of the inflammatory process, and the amount of constitutional power of the subject of the disease. As a rule, however, suppuration takes place.

"When the mamma, in its state of full expansion and perfect functional activity, becomes the subject of an interference, the result is very commonly a diffuse or nodular inflammation and the formation of an abscess. A sudden stoppage of the milk soon after the lactation has been established is apt to produce inflammation, and the same result, or a degree of it, sometimes follows the weaning of the child after a long course of suckling. The disturbing cause, whatever it may be, acts upon the mamma when its function is at its greatest intensity, and a characteristic effect is inflammation and abscess."—*Creighton.*

In a general way, inflammation attacks the breast gland when in a state of activity; and it is exceptional for the passive organ to be the subject of this process; for out of 102 consecutive cases under my observation, 79 occurred during lactation, 2 during pregnancy, and 21 in patients who were neither suckling nor pregnant. Moreover, three-fourths of the cases that occurred during lactation attack patients during the first two months. In many of these, a cracked nipple was the assigned cause, but I am disposed to think with Mr. Ballard, that abscess in the early months is due to the searching of the child after milk before the gland is filled, in patients who have neither sufficient power to secrete milk, nor to resist the inflammatory process when once originated. The affection is more common in primiparæ, and the right breast is more frequently affected than the left in the proportion of 5 to 3. In some cases, the rapidity of the process is very marked, an abscess forming within a few days, while in others it is most insidious; chronic abscesses have been often mistaken for new growths, and amputation of the gland performed under this false diagnosis.

Abscesses occur in *infants' breasts*, and they are too commonly the consequences of an ignorant nurse applying pressure to the glands in which milk is found, or friction to "rub away the milk." The milk appears to be more abundant in the male than in the female infant.

They are also met with in the male subject from injury or other causes.

Chronic mammitis in the boy or girl is by no means a rare affection, the undeveloped gland becoming indurated and very painful; yet such cases rarely suppurate.

TREATMENT.—The activity of the treatment of the affection we are now considering must be regulated by the acuteness or severity of the inflammatory process, and the nature of the constitutional and local symptoms to which it may give rise. As a broad truth, it may be confidently asserted, that the inflammatory process is of a low type and of a destructive nature, and, that as the constitutional powers are generally feeble, nothing like lowering measures should be adopted, but, on the contrary, soothing local applications and constitutional tonics with sedatives are absolutely demanded.

In cases occurring during lactation no other principle of treatment than those I have just laid down should be entertained. Under such conditions, soothing fomentations to the breast, either of warm water or some medicated solution, such as the decoction of poppies, give most relief, although a light linseed poultice or some spongiopiline may be well employed. In young, robust women, where suckling is impossible, the application of laxatives and powerful purgatives may be called for.

Rest in the horizontal position affords striking comfort, and, when it can be carried out, is of great practical advantage; but, if this desideratum cannot be secured, the whole breast must be supported by a band or linen sling. During this time, tonics in such a form as can be borne and may be indicated should freely be given, quinine probably being the best. Such stimulants as wine or beer must be cautiously administered, though the cases are few which do not require such an addition to their diet, while plenty of nutritious food should be allowed. A sedative at night is also very generally required, and Dover's powder in ten-grain doses is the best form, for want of sleep from pain is a common accompaniment. A mild purgative in the early stages of the disease may be necessary, but excessive purgation should be avoided, since the object of the surgeon is to supply power, and not to remove it—to soothe and not to irritate.

On opening a mammary abscess.—There is a great difference of opinion among surgeons about the propriety of opening a mammary abscess. Some think the best practice is to let the breast alone, and leave the operation to nature; while others advocate an early opening. But in neither am I disposed to coincide, for while I regard it as a right practice to postpone puncturing the organ as long as possible, and not to show any over-anxiety in evacuating the pus; on the other hand, I know that when the abscess is left to itself much unnecessary suffering is endured and a considerable sacrifice of skin often follows, entailing a long convalescence and an ugly cicatrix. The practice I consequently generally adopt is to leave the parts alone till pointing has taken place and then to puncture, making my incision in a line radiating from the nipple of the patient. By adopting this practice, any unnecessary pain is saved, for the appearance of pointing is directly under the observation of the surgeon, and it is not necessary to make frequent and careful physical examinations. Of course, some gentle manipulation is absolutely called for to enable the surgeon to form an opinion, but the eye, and not the finger, is the chief guide. Much manipulation of the gland is both painful and injurious, and an absolute abandonment of all local surgical treatment can only be condemned.

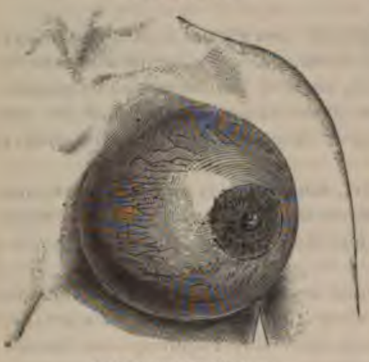
Warm fomentations in all stages of the disease are very grateful to the patient, and may be freely used; and when early suppuration threatens, a light linseed poultice is probably the best application. When the abscess has discharged, the poultice may be laid aside, and wet lint alone employed, as constant poulticing soddens the integument and retards the process of convalescence.

On the treatment of chronic abscess of the breast.—The existence of a chronic abscess having been made out—a point, by-the-bye, which will be returned to when the subject of the diagnosis of a mammary tumor is discussed—it becomes an important question what treatment should be pursued.

When the abscess is small, causing little or no annoyance, it may be left alone, and, under the influence of tonics and local pressure by means of strapping, the fluid may be absorbed, and such a result is occasionally brought about. In the majority of examples, however, some more active treatment is necessary, and of these the evacuation of the pus is the chief point. If the abscess is large and deeply seated—a common condition—the drawing off of its contents by means of a trocar and canula is the usual practice and is generally believed to be the best; but it has this disadvantage, that the wound generally soon closes, and a second operation is required. The same treatment may be again resorted to with the same results, and this drawing off of the pus and the subsequent closure of the wound may go on for many times. At last, however, the opening remains patent, and the abscess contracts, leaving a sinus in the majority of cases. Under these circumstances, a bolder plan of treatment seems absolutely demanded, as time is an important element in the consideration of any plan of treatment. The best method appears to be a free opening at the first operation, the surgeon subsequently inserting a strip of oiled lint into the cavity of the abscess for a few hours to prevent the wound closing.

Submammary abscess.—Abscesses occasionally form *behind* the breast gland over the pectoral muscle, and when they do, the gland is pushed forward in a way that is characteristic. The abscess (Fig. 395), as a rule, points below the breast. Such abscesses should be opened in the most dependent position as soon as any indication of fluctuation can be made out. This disease is very slow in its progress.

FIG. 395.



Submammary abscess.
Drawing 401^{45}, Guy's Mus., Birkett's case.

On the treatment of sinuses.—The treatment of sinuses in the breast, as elsewhere, is always a task of difficulty, and in certain cases all plans will fail. The one principle of practice which seems to be the most valuable is the establishment of a dependent outlet; and for this purpose the introduction of a drainage tube is a simple and successful practice. If there are many sinuses, some pressure may be employed by means of strapping, care being taken that the openings are left uncovered to insure a free passage for their discharge. Superficial sinuses may be slit up, when other means fail, and in very chronic cases some irritant, such as iodine, may be injected, to excite a fresh action. The great principle of practice in these cases, however, appears to be that to which I have already alluded, although other means may at times be demanded.

CHRONIC INDURATION OF THE GLAND.

This affection occurs when, from some cause or other, the gland is morbidly excited. It is chiefly found in unmarried women between the ages of thirty-eight and forty; though it occurs in the married, and then, as a rule, in the sterile. It is usually associated with some catamenial irregularity or general disturbance, and more particularly of the nervous system.

The affection is known by the excessive sensibility of the indurated gland on manipulation, the nervous excitement the examination causes, *the total absence of any local indications of a tumor when the fingers are placed flat upon the part*, and the induration of the gland or lobe of the gland, when the organ is raised from the pectoral muscle and pinched.

The *treatment* consists in correcting what is wrong in the general condition of the patient by means of iron, tonics, and alteratives, and soothing the affected part. Cold lotions are at times grateful, while at others a belladonna plaster affords relief, with or without pressure. Large breasts should be suspended, and all should be protected by cotton wool from the risks of injury.

The irritable mamma of young girls is closely allied to the affection just described; and is associated with a morbidly sensitive condition of the mammary gland and parts around, and often with some induration. It is an affection closely connected with the pelvic generative organs which are mostly found to be not acting fairly, as indicated by catamenial irregularity, &c. This condition is, doubtless, at times excited by depraved habits. It should be treated on the same principle as the last affection.

ON TUMORS OF THE BREAST.

THEIR CLINICAL EXAMINATION AND DIAGNOSIS.

Tumors of the breast may rationally be accounted for by following out the functional aberrations of the organ, and in proof of this the student should study carefully the highly suggestive and valuable work of Dr. Charles Creighton,[1] who has shown that "the investigation of breast tumors reveals merely the working of the physiological law of healthy mammary activity under altered circumstances, that various degrees of disordered function may result in various kinds of tumors," and that tumor disease of the breast is "essentially a disorder of function."

The breast, in passing from its "resting" or inactive state to that of full activity, undergoes during the entire period of pregnancy, a process of "evolution" which is characterized in its different stages by certain cell changes within its acini and transport of cells without; and, in the return of the gland to its quiescent condition on the subsidence of lactation, a process of "involution" in which a parallel series of changes acting in an inverse order is to be observed, the functional subsidence of the gland being spread over a shorter period of time than its gradual awakening during pregnancy.

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[1] 'Contributions to the Physiology and Pathology of the Breast,' 1878.

When the functional stimulus of the mamma is acting at its *lowest* point at the beginning of "evolution" or the ending of "involution," the secretory product is a large granular yellow pigmented cell, which cells are found within the secreting acini, in the connective tissue spaces outside the secreting structure, and likewise in the lymph-sinuses of the subjacent lymphatic glands, these cells being the waste products of a feeble degree of secretory activity; and, if the mammary excitation were always to act at that degree of intensity, the secretion it may be said would always be in the form of large granular pigmented cells.

At the *next appreciable advance* in the intensity of the stimulus, the product formed in the gland may be described somewhat generally as a large granular nuclear cell, which is nothing else than the crude epithelium of the middle period of the breast's unfolding, in which an imperfect secretory force resides.

Coming *still nearer to the full excitation*, the cellular ingredients are fewer and the mucous production much more abundant, and finally, when the *stimulus is at its height*, the mucous fluid has given place to a fatty fluid, and whatever cellular elements the secretion contains are the well-known colostrum cells which approach most nearly the perfect secreting cell. The periodical unfolding of the breasts, which is an obvious accompaniment of each pregnancy, is thus characterized by a progressive series of immature secretory products which necessarily run to waste. The epithelial cells are not transformed into milk till the time of delivery and during the period of suckling following; but the functional action of the breast has been at work all through the pregnancy, and has advanced in intensity just as the secreting structure has advanced in its unfolding. The various stages of unfolding have corresponding secretory products, becoming less and less crude, and as there is a similar series of more rapid but exactly parallel waste products in the unfolding, it is a legitimate inference to ascribe "a special kind of secretory product to a certain degree of intensity of the glandular force."

When the breast gland is disturbed from its resting state by a cause other than pregnancy, and, in consequence of some morbid excitation is urged into a kind of evolution process, the steps of its unfolding are less orderly than in the normal evolution, and the "spurious excitation" never carries the gland to the end of its unfolding or to the perfect degree of its function. And, although the morbid excitation may be said to correspond in its intensity to a stage of the normal evolution, there is this fundamental difference, that the corresponding stage of the normal process is transient, giving place to a stronger force while the morbid process continues indefinitely at the same enfeebled level. As a consequence, the cell that should have been thrown off from the acinous as waste almost as soon as it was formed, remains in the place of its origin to multiply, and, with its progeny, to infest the glandular structure of the breast either as intra- or extra-acinous accumulations. Indeed, according to Dr. Creighton, it is upon deviations from the physiological track such as these that the existance of a tumor depends.

Thus "a circumscribed tumor arises at a particular part of the gland where the spurious excitation has advanced to a certain stage of evolution or unfolding; in that particular region, probably a territory defined by the bloodvessels, the functional force has acted at a uniform imperfect level for a length of time, the inevitable cellular waste of the crude secretion has accumulated within the acini or around them, and the foundation of a tumor has been laid.

In the healthy action of the organ there is a provision for the disposal of the very considerable amount of cellular waste material by means of the neighboring lymphatic glands. In passing from the secreting acini and in traversing the stroma of the gland, the waste cells often acquire a spindle form; and although these cells are not always distinguishable from the connective-tissue cells of the part, there is, especially in the bitch, a class of pigmented epithelial cells in which such changes of form and position can be clearly traced. The spindle-shaped waste products are the type of the peri-acinous cell-collections in cystic- or adeno-sarcoma.

So far as relates to the large nuclear cells, the *intra*-acinous collections of them correspond to the structure of medullary cancer, and the *extra*-acinous infiltrations of the same cells are a distinguishing feature of scirrhus. "The distinguishing feature of the less malignant form of tumor is that the spurious *functional* activity comes nearer in the degree of its intensity to that of the perfect secretory *force*, the transformation of the epi is a more real transformation, and the cellular waste is reduced, in part at least, class of fibre-like or crescentic elements that characterize the myxomatous an benign issues of the tumor process."

"The circumstance that the unknown diseased excitation most commonly bef gland when it is in the state of rest is of the first importance in accounting for the tion of a tumor. Whether the disturbance be a mechanical injury, or a sympat excitement in the ovaries, or of a more general emotional nature, it comes upon th in its resting state. The breast can react in no other way than by following th what slow process of its normal evolution; without the intermediate stages of u it cannot reach the perfect degree of its functions in which there would be in from danger. The intermediate stages are necessarily associated with the form crude cellular products; it is at one or other of the intermediate stages that th force delays, and the corresponding cellular secretion of the gland thereupon ass character of a formative or tumor process."

"The circumstances of the functional disturbance are never exactly the sam two cases, consequently, the respective modifications of structure, or, in other w structure of the respective tumors are never exactly the same."

When a tumor forms in the breast within the period when the function ma awakened to its full and healthy vigor, that is, during the period of its struc functional maturity, a resolution of the disease or a dispersion of the diseased may be looked for. But, when it appears at or near the climacteric years, when is suffering an effacement of its secreting mechanism and a withdrawal of its force, no such a result can be expected, and it is at this period that the greater intractable tumors occur.

"It is the climacteric effacement of the breast that gives a peculiar charac disease in women, and there are well-marked structural differences in the tumo ing as they appear before or after that period. Those that develop after the c years are perhaps the most common, as they are certainly the most intractable have been the real source of ambiguity in the pathology of the organ. That depends upon the circumstance that they occur in an organ which is graduall has lost its characteristic structure." Where the normal itself is vanishing, the from the normal are elusive.

It seems probable, therefore, from Dr. Creighton's investigation, that the s sarcomata, myxomata, and carcinomata have their type in a series of progressi which the gland undergoes in its physiological evolution. The feebler the inter function, the more cancerous the disease; the higher or more advanced the evol the resting state, the more benign the tumor.

THE CLINICAL EXAMINATION AND DIAGNOSIS OF A BREAST TUMO

From a practical point of view, tumors of the breast may be divided into *infl* *adenoid* or innocent, and *malignant*, for simple hypertrophy or excess of gro gland can hardly be classed among the tumors.

The first point a surgeon has to determine when consulted by a patient who thing the matter" with her breast, is practically the existence or non-existence *i. e.*, is there a new growth developed behind, and in connection with the mamm or, is the disease from which the patient is suffering situated in the substa glandular structure itself? This first and most important question ought to before a further step can with safety be taken; before the formation of a correc of the case can be made; and it is quite impossible to magnify its importan this, however, considerable care is necessary, and some manipulative skill mus into requisition; as a careless examination will surely end in an uncertain dia with this, a failure in treatment must necessarily follow. In examining a br fore, with diagnostic intentions, the surgeon with the whole gland well in v place the palmar surfaces of his fingers over the suspected spot, and taking t his hand manipulate it gently and in every part with his fingers and thumb; isolated tumor can be found, he will in all probability detect its presence; if, h is uncertain upon this point, he should make the patient lie down, for "if a sitting or standing, and the breast is grasped by the finger and thumb, when in the gland itself exists, a sensation is felt as if a tumor were present. If, now, surface of the fingers be pressed flatly against the chest in the same part, nothi able will be distinguishable. If a tumor or new growth exists, however, it is immediately perceptible. But if a doubt arise in the matter, the patient should recline when under examination; and then, if there be a tumor, it is immediately manifest to the touch, and often to the eye."—*Birkett.* Having then detected the presence of a tumor, that is, an independent growth developed in the neighborhood of the breast gland and probably in connection with it, the question arises as to its nature. Is it a simple or a malignant tumor? If the tumor be movable and hard, if quite free, or has but a very uncertain connection with the gland structure, there is a strong probability that the tumor is of a simple nature; and, if it has existed for several months, this probability becomes stronger, for the *cancerous* tumor has a tendency even when primarily developed as a tuber or as an independent structure, to associate itself and becomes connected with the neighboring tissues; and if this has not taken place, the absence of these conditions enhances the probability of the simple nature of the growth under examination. If the patient is also young and healthy, and no other abnormal conditions, either of the breast or neighboring structures are to be detected, the probability becomes a certainty, and the presence of an "adenocele" may be determined on—this tumor being synonymous with the chronic mammary tumor of Sir A. Cooper, the mammary glandular tumor of Paget, the sero-cystic sarcoma of Brodie, or the adenoma of Birkett.

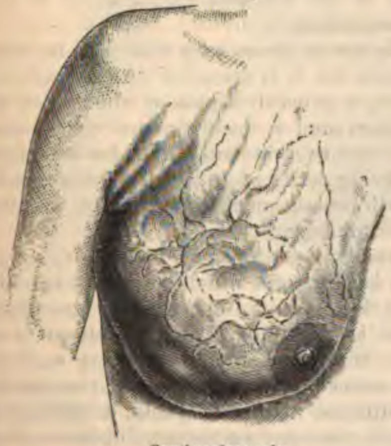
These *adenoceles* are found, as a rule, in the young and unmarried, and in the apparently healthy and robust, although occasionally they occur in the aged. They appear during the period when the procreative organs, and among them the mammary glands, are in a state of "developmental perfection;" and when they occur in married women, are most frequently developed during pregnancy or suckling. They are never associated with any other symptoms than such as can be produced mechanically by their presence, and never involve the integument except by distension; nor is the skin ever infiltrated by any new material. They are never accompanied by any secondary enlargement of the absorbent glands nor associated with any secondary deposits; they cause no cachexia nor undermine the health; but affect the patient solely through local influences, and demand treatment chiefly from local considerations. They may be found in either breast, occasionally in both, and are constantly multiple, two or more tumors being often found in the same gland.

From my notes of eighty-one cases consecutively observed—

22 appeared under the age of 20.
28 between 21 and 30 years of age.
18 " 31 " 40 "
11 " 41 " 50 "
2 above the age of 50.
37 were in single women.
31 in the married and prolific.
12 in the married and sterile.

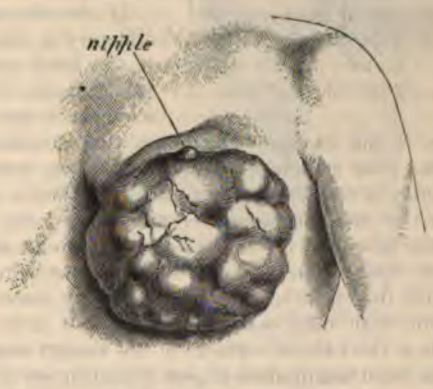
As long as these tumors remain small and quiescent, they are of little importance; and, being movable, are readily diagnosed; but when years have been allowed to elapse, and their growth has increased, and, from their greater size they have become burdensome and press on neighboring structures, they are neither of small importance nor are they readily to be distinguished. But yet, if careful observations are taken, an error in

FIG. 396.



Cystic adenocele.

FIG. 397.



Solid adenocele of six years' growth, in A. S—, æt. 36.

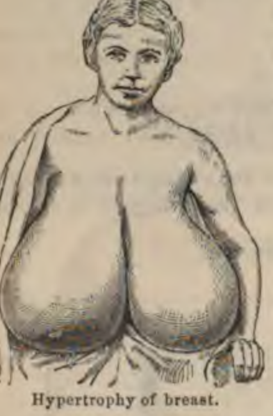
diagnosis should not be made. For, although the breast itself may be much pressed on or even expanded over the tumor, it will still exist, and, on careful examination, its presence, as a rule, will be made out. The nipple, although flattened from the extreme glandular expansion, can still be seen (Fig. 397); and is rarely retracted. The integuments may be stretched to an extreme point, yet will they still be movable and sound (Fig. 396), although some inflammation from over-distension may have made its appearance, and large veins are always to be observed meandering in the healthy tissue. The tumor, if solid, may appear lobulated (Fig. 397), and if containing cysts, fluctuation may be detected. Still, the disease is essentially a local one, and affects the patient through purely local conditions. It is to be treated only by excision, and the gland, as a rule, should be left unharmed, the tumor being turned out of its capsule. In extreme examples, however, the breast is so stretched out as to be useless, and then must be removed. In the patient from which Fig. 397 was taken, this was the case. She was a woman æt. 36, and the tumor was of six years' growth.

The diagnosis of a tumor which is evidently caused by some partial or general enlargement or infiltration of the mammary gland.—Let us suppose that the surgeon has a case of disease of the breast before him in which the structure of the gland is itself involved, and there is no independent movable tumor, such as we have been considering; but that on manipulation it is evident the growth, whatever it may be, is intimately connected with the gland structure.

What is the case? Have we an inflammatory affection only of the organ, or some hypertrophy or innocent enlargement? Is it a simple or a malignant disease? When the manipular indications of the mammary gland are those only of enlargement, is such a condition due to pregnancy, or the product of a simple hypertrophy, confining the meaning of that term to an excess of growth?

If the increase be due to hypertrophy, which is a somewhat rare condition, it has been to a certainty of a chronic nature, and its increase slow and growth painless. The gland will appear simply enlarged, with no increase in action beyond that which growth demands, although this increase in growth may be very great. It is found mostly in young women, but I have seen it in the male; at times it affects only one gland. In the case from which Fig. 398 was taken, each gland on removal weighed about fourteen pounds. I saw the case some years ago at Grantham with my friend Mr. Shipman. The breasts were subsequently removed by Sir W. Fergusson.

FIG. 398.



Hypertrophy of breast.

That the affection is something more than a mere increase in the growth of the gland is proved by the fact that, in a woman, æt. 43, who had this disease in her right breast of thirteen years' growth and not in her left, and had a child, no milk was secreted in the diseased gland, while in the sound one there was abundance.

If the enlargement be due to pregnancy there can be little difficulty in the diagnosis, for it is attended with an activity of the local circulation, a general fulness of the gland, an enlargement of its veins, and a darkening of the areola, which will not fail to excite suspicion. Besides this, *both glands* will be similarly affected, a coincidence which is rarely seen in any morbid condition. The very suspicion of pregnancy, however, will be enough to call attention to other points, by which a solution of the difficulty can be obtained.

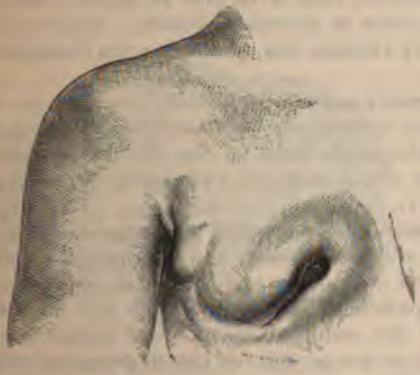
Is the enlargement to be explained by any inflammatory condition? I do not mean an acute inflammatory condition, for such an affection has features which are too characteristic to allow any mistake in diagnosis being made, but is this infiltration of the gland which is present to be explained by some chronic inflammatory change, such as is so frequently found in the female breast; or is it the early stage of an infiltrating cancer? The answer to this query is not always easy. In middle-aged patients, when cancerous affections may be looked for, the presence of an indurated mammary gland, wholly or in part, must always be regarded with suspicion, and, if the case be recent, I believe it to be an impossibility to form any certain opinion as to its true nature. If the induration of the gland be the only symptom, and is associated with a sharp or even dull pain, either a simple chronic inflammation of the gland may be indicated or the early condition of a cancer, and, under such circumstances, it is as well to wait before giving any positive opinion. If, however, much time has already passed, say many months, and no other symptoms have made their appearance, there is some ground for the hope that the enlargement may be due to inflammation, since infiltrating cancers are not generally inactive—are not stationary, as a rule—and soon give rise to other symptoms, such as some, though it may be slight, enlargement of the absorbent glands; some slight dimpling or drawing in of the skin, an important sign (Fig. 400); or, some marked symptom such as infiltration of the integument or a retracted nipple. It should be remembered, however, that a retracted nipple is only an accidental symptom such as may be caused by several conditions, and is not by any means of itself characteristic of cancer. But if any or all of these symptoms show themselves soon after the first appearance of the lobular enlargement of the mammary gland, an opinion as to the cancerous nature of the growth may be confidently expressed. If, on the other hand, none of these symptoms make their appearance, and the induration or infiltration of the lobes of the gland remains stationary, or shows some tendency towards improvement, the probability of the simple character of the disease gains ground. When this induration of the mammary gland appears in a *young subject*, there will be no reason to suspect a cancer, and it should rather be regarded as the result of some slight inflammatory effusion. Under such circumstances there will generally be some increase of pain after examination, but an absence of any other local symptom. There will probably be some irregularity of the catamenia and some signs of general excitability of the patient. But, as a local affection, there will be only the one symptom of induration of one or more lobes of the mammary gland, which, *in the absence of all other signs*, may with safety be regarded as inflammatory. The same argument holds good when the disease disappears at a later period of life, although suspicions of a cancer should rightly be excited; still, the positive diagnosis must be postponed till, by the lapse of time, some other symptoms such as those already mentioned make their appearance, to clear up all doubt, or by their absence, prove the innocent nature of the affection.

CARCINOMA OF THE BREAST, OR CANCER.

This affection is found either as an *infiltration* of the gland, wholly or in part, or as an independent tumor or tuber within the meshes of the gland—*tuberous cancer*. It may likewise be met with associated with cysts—*cystic cancer*, this being only a variety of the other forms.

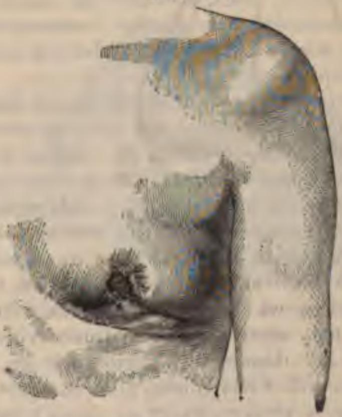
In the infiltrating form the gland appears hard, inelastic, and incompressible; as the disease progresses, it seems to contract and to draw all the parts around together and gradually to infiltrate them. In this way the nipple often becomes drawn in or to one side. At times, after having been drawn in, it becomes infiltrated with the disease, and becomes again prominent; at others, by the contraction of the gland, it may be strangulated, become œdematous, and then slough off. The skin is at first dimpled, then puckered, and at last infiltrated. The breast also, from being a movable organ, becomes fixed; so fixed, indeed, that it cannot be separated from the pectoral muscle.

FIG. 399.



Infiltrating cancer and retracted nipple.
Drawing 400^{18}, Birkett's case.

FIG. 400.

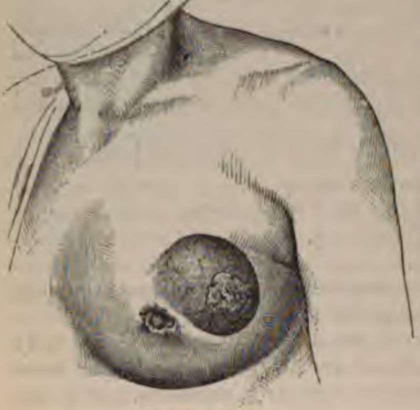


Infiltrating cancer with puckered integument.
From model.

This form of cancer is the more common. The disease may appear in one lobe or in all, and be slow in its progress or rapid, but in every case its progress is much alike; generally, however, this infiltrating form of cancer assumes the characters of the tuberous. In Figs. 399, 400 these changes are clearly shown.

Tuberous cancer commences as a circumscribed independent growth within the gland structure, with a well-defined capsule separating but not infiltrating the tissues. Sometimes two or more tubers appear together, and these may at last coalesce. This form, unlike the infiltrating does not contract, but grows in all directions, involving all the parts which it touches, pushing the breast to one side, or drawing it to itself (Fig. 401). It often attains a large size, giving rise to an irregular lobulated tumor. It is at times soft in consistence, when it is called *medullary* cancer; when firm, it is known as *fibrous:* when jelly-like, *gelatiniform;* and more rarely it is black or *melanotic.* As it grows forward, it may involve the skin, break and ulcerate, giving rise to the appearances formerly called *fungus hæmatodes,* this form being always accompanied with hemorrhage.

Fig. 401.



Tuberous cancer.

In both forms, the lymphatic glands in the axilla above the clavicle, or on the side of the neck, will sooner or later become involved; and, when the skin is implicated, this symptom soon appears. As the glands enlarge, nerve pains down the arm appear, and œdema of the arm commences from the mechanical obstruction to the venous circulation of the extremity caused by the enlarged glands. At times a serous effusion takes place into the pleural cavity of the affected side sufficient to destroy life.

In some rare cases of cancer the disease appears as a *brawny* infiltration of the breast and integument over it, some erythematous redness and œdema being mixed with it at its onset. These cancers are of the worst kind, and speedily destroy life.

In other cases, mostly chronic, the disease is more cutaneous, and shows itself as a tubercular affection of the skin, which gradually spreads, till at last the part affected seems skin-bound. This condition may be limited or extensive; and occasionally involves the whole of one side. I have recently had a case under observation in which both breasts, the sternum, sides, and half the dorsal region of the back were thus involved. At times this tubercular development is associated with acute or recurrent disease. In rare examples it occurs as a primary affection and is very chronic, the tubercles even disappearing by atrophy.

A cancerous tumor of the breast most frequently appears in middle life, that is, when the procreative organs are verging towards their natural period of functional decline, such a period taking place at an earlier date in the single than in the fruitful woman. It attacks married women more frequently than the unmarried, and, when infiltrating or involving the breast-gland, is seldom stationary.

As the disease progresses unchecked, ulceration of the integument, preceded by a softening down or breaking-up of the tumor itself will soon appear, and with this, the characteristic infiltration of the margin of the wound will occur and give rise to indurated, everted edges. A general cachexia from the pain and wasting discharges will soon show itself, and more or less distinct evidences of the complication of other organs become apparent. Under such circumstances, the end is not far off, for the disease has run its course, and with it the powers of its victim have become undermined, for the victory remains with the strongest. In a general way, a cancer runs its course in two or three years; though sometimes it is most chronic in its action.

To illustrate some of the points connected with this subject the following analysis of 400 cases may be of value. The cases are taken from my own notes; 180 occurred in Guy's during the period of my registrarship many years ago, and 220 are from my own case-book since.

The *disease made its first appearance*—

In 17 cases, or 4 per cent., under 30 years of age.
In 108 " or 27 " between 31 and 40 years of age.
In 144 " or 36 " " 41 " 50 "
In 101 " or 25 " " 51 " 60 "
In 29 " or 7 " " 61 " 70 "
In 1 over 70 years of age.

I have, however, seen a case of cancer of the breast in a patient aged 28, and one of a year's standing in the breast of an old lady æt. 96.

Of these 313 were married, 77 were single, and 10 were widows.

Of the 313 married, 235 were prolific and 78 sterile. A large proportion of the prolific women were so to an extreme degree, ten and more children being a common note to find recorded. Married women and those in whom the gland has been the most active, are apparently more liable to cancer of the breast than the single when the period of gland activity has passed.

194 of these examples were in the right breast, 187 in the left, and 19 in both.

In 140 the disease had existed a year or less.
In 99 between 1 and 2 years.
In 23 " 2 " 3 "
In 15 " 3 " 4 "
In 13 between 4 and 5 years.
In 9 " 5 " 7 "
In 6 " 8 " 9 "

In four cases, the disease had existed ten, twelve, fourteen and twenty years respectively, and the form of cancer in these of long standing was the atrophic.

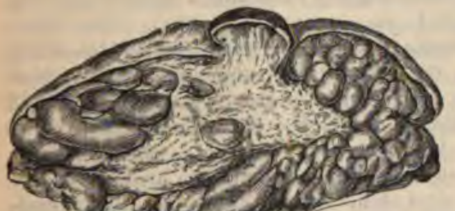
With respect to any *hereditary history* of cancer in the 400 cases, although carefully inquired into, I found it to exist in only 47 or nearly 12 per cent.; and, in 35 of these cancer was reported to have occurred in one member, in 11 in two members, and in one in three.

In 7 of the 47 cases the relative was on the father's side, in 23 on the mother's, and in 7 it was found among the brothers or sisters. In 5, it had attacked the aunts, in 3, cousins, and in 1 a grandmother, although in these the point was not stated respecting the paternal or maternal relation. These facts are enough to indicate that where an hereditary tendency exists, it is more powerful on the mother's than the father's side.

In a large proportion of the cases in which an hereditary history of cancer was traced, the cancer was of the breast.

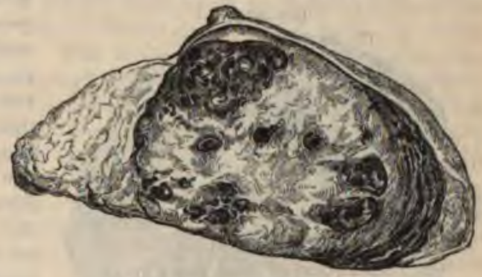
A section of an infiltrating cancer is well shown in Fig. 402. A section of the tuberous form in Fig. 403. For the microscopical appearances of cancer *vide* Fig. 32.

FIG. 402.



Infiltrating cancer of the breast. Drawing 409,^{18} Guy's Mus., Birkett's case.

FIG. 403.



Tuberous cancer. Birkett's case.

Colloid or alveolar cancer is occasionally seen in the mamma, although in a clinical point of view the growth presents no such features as to enable the surgeon to recognize its presence. In Fig. 27, page 103, a cancer of the kind is illustrated. In it, the clinical features of the affection were those of the cystic disease. It is found in the gland as an infiltrating and tuberous growth.

To the eye, the colloid disease has a peculiar aspect, its jelly-like semi-transparent material of all tints of pink and red from degrees of blood-staining being divided by thin meshes of fibre tissue into cells of different sizes. The way the jelly-like structure oozes from its cells, and the slight changes that take place in it after immersion in spirit, are its chief characteristics.

It ought to be treated by excision of the whole gland.

Cystic Tumor of the Breast.

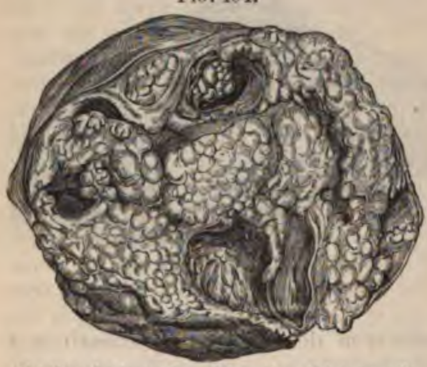
The simple sero-cyst is usually found single in the mammary gland, and appears as a small hard lump in one spot which is at times painful, but often not. As it increases it becomes more globular and dense, sometimes being of a stony hardness; while at a still later date, it may afford the sensation of fluctuation. If left alone, it may so enlarge as to come forward and even burst, discharging a thin watery *non*-albuminous fluid, and then collapsing. In rare cases, the disease is thus cured; but more commonly, the fluid re-accumulates.

"The cyst wall of this tumor," writes Birkett, "is very thin, composed of fibre tissue, firmly attached to the surrounding parts, and lined with squamous epithelium. It is always perfectly closed, and never communicates with a duct."

Such a cyst should be punctured with a trocar and canula and some cold lotion applied, for, by this means many are permanently cured. Brodie employed alone, without puncture, a lotion made up of an ounce of the solution of the subacetate of lead and three ounces and a half of both spirits of wine and camphor, which was to be applied on a piece of folded flannel, and renewed every three or four hours until the skin over the tumor had become inflamed; the application to be reapplied after the lapse of two or three days.

Besides the simple serous cyst, many examples of tumors of the breast come under the observation of the surgeon, the diagnosis of which is much obscured by the presence of cysts, or rather of what Mr. Birkett describes as capsules, containing fluid of divers characters. For the development of a cyst in the majority of tumors is a mere accident due to the effusion of fluid, probably serum, more or less blood-stained into the connective-tissue of the part the fluid separating the solid growth and so forming an apparent cyst. Such a cyst, however, is not a new development, like the more solid portion of a tumor, nor is it in any way to be compared with the simple cystic formations which are found in the neck or other portions of the body. The existence of the false cysts, therefore, such as I have briefly sketched, in any of the breast tumors, whether adenoid or malignant, is to be regarded as a mere accident, and ought to have no weight in determining either the innocency or malignancy of the growth under examination; they are the product of a mechanical cause, may occur in either form, are not special growths nor of any intrinsic importance. The diagnosis of the tumor containing such cysts rests consequently on other points, and more particularly on such as have been already indicated. As a rule, these so called cysts are found in the less firm and solid forms of tumor in such as contain less cellular or connective tissue, and in the more rapidly developed rather than in the slowly formed. We thus find in *one* form of cystic adenoma, a more or less solid tumor, the growth being more lobulated and loosely connected where the false cysts or capsules exist. In a *second* class of cases loose pedunculated growths will be seen lying within these capsules, with their floating extremities bathed with the so-called cyst contents (Fig. 404). The different forms assumed by these tumors depending upon the amount of connective tissue which binds together the several lobes and lobules, and the dimensions of the interspaces which go to form the false cysts. In a *third* class, however, the true cystic adenocele of the breast, the adenoid solid elements are developed within cysts composed of dilated ducts. In all, the elementary structure of the growths whether these are dense and compact, loose and pedunculated, within false cysts or in dilated ducts, simulates the structure of normal gland tissue. In some, the cæcal terminations of the ducts are the most prominent, and in others, the ducts and sinuses; while in a few true milk or cream secretion exists, precisely similar to that secreted by the breast. In Fig. 404 every variety of this affection can be seen. In all probability, however, all adenomata are developed in cysts as intra-cystic growths. Dr. Goodhart, in an able paper has supported this view ('Edin. Med. Journ.,' 1872).

Fig. 404.



Section of adenocele, with cystic and intra-cystic growths of all kinds.

CYSTIC CANCER.

The pathology of cystic cancer is identical with that of cystic adenoma, while the cysts in the one instance contain the more or less solid characteristic lobules of the adenoid growth, and in the other, are filled with the less developed and more irregular, but equally characteristic material which goes to build up the cancerous tumor. The diagnosis of these cancers rests, therefore, upon such points as have been already described under a former heading.

ON THE DIAGNOSIS OF THE "TRUE CYSTIC ADENOCELE" OF THE BREAST.

The remarks which have been already made respecting the importance of cysts in the innocent and malignant tumors of the breast are not applicable to all cases; inasmuch as to this rule, as well as to others there is an exception, and in the present case, the exception is to be found in that form of cystic disease of the mammary gland which is essentially a cystic disease of the gland itself, and more particularly its secreting ducts, differing in this way from the other forms of cystic adenocele which are new growths, developed independently of, though allied in structure to, the breast-gland itself. This true cystic adenocele, however, is of an innocent nature and pathologically allied to the genuine adenocele. It is the tumor originally described by Sir B. Brodie as "arising by a dilatation of portions of some of the lactiferous tubes," and, by Mr. Birkett, as duct-cysts distinctly referable to the dilatation of a duct, or to a connection with one, and containing growths which appear to spring from their walls, and these two forms of cystic adenocele are strictly analogous in their nature. In both, the pedunculated or floating bodies possess a structure allied to the breast-gland, and are composed of more or less distinct cæcal terminations of newly developed ducts with variable quantities of true connective tissue. This affection is more common in middle than in young life, for out of 14 cases 3 only occurred in women under 30; in 11, in women over 40, while 1 was as old as 71 ('Path. Trans.,' vol. xvii, p. 283).

How, then, is such a tumor to be made out? and what are the special symptoms which characterize it from the other forms of mammary tumor?

First of all, being an innocent tumor, it will be found to affect the patient in a purely local manner as all other adenoid tumors. It is a local disease, which at no period of its growth and in no way will affect the patient otherwise than through local causes. It is never associated with secondary glandular enlargements or with deposits in other tissues, as the cancerous tumor, and it can, therefore, be by local symptoms only that a correct diagnosis is to be made.

The tumor, being a *genuine cystic disease*, is always made up of cysts filled with intracystic growths in different degrees, and *it is also a disease of the gland itself*, the cysts having a distinct relation with the gland ducts. The cysts having, therefore, in the majority, if not in all cases, some communication through the nipple with the external surface, can be partially emptied of their contents by pressure through the nipple of the affected organ. As a result, this discharge from the nipple must always materially tend to confirm the impressions which may have been formed by the careful observation of the case, and by the presence of those conditions to which attention has just been drawn.

Consequently *a cystic tumor of the mammary gland* in a healthy woman, unattended by any other than local symptoms, and associated with the discharge of a clear or colored viscid secretion from the nipple, which can be induced or materially increased by pressure, may, with considerable confidence, be set down as the *true cystic adenocele* of the breast. The false adenoceles or other tumors, which have but little if any connection with the true gland-tissue, are new growths partaking of the nature of the breast-gland according to the universal pathological law, that all new growths partake of the nature and peculiarities of the structure in which they are developed.

GALATOCELE.

This is a milk tumor found in the breast during lactation, the result of some retention of milk in an obstructed or ruptured duct, the secretion being either fluid milk-like, or more solid and creamy, owing to the absorption of the more fluid elements. Prep. 2290^{50}, 2290^{80}, and 2299^{40}, Guy's Museum, illustrate these points. It usually occurs somewhat suddenly during suckling, and is indicated by a painless fluctuating swelling, unaccompanied by any constitutional disturbance. These cysts at times attain a large size. Scarpa has recorded a case in which two pints of milk were removed from the tumor. It should be treated by an incision into the cyst, leaving the walls of the cavity to granulate.

Other Tumors of Breast.

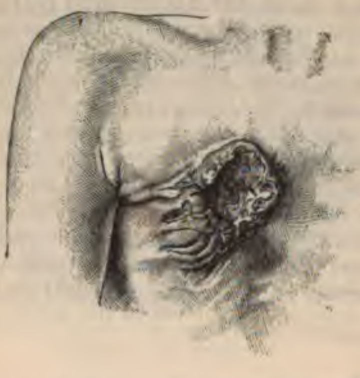
Adenomata or adenoceles, cystic or otherwise, are not, however, the only innocent tumors of the breast, as the *sarcomatous* are occasionally met with; these being generally more succulent and less solid than the adenomata and more rapid in their growth, while they have also a greater tendency to return after removal. I removed such a tumor in 1868, which weighed nearly five pounds, from the breast of a woman, æt. 34 ('Path. Trans.,' vol. xix). They are more closely connected with the breast than the adenomata, although they do not infiltrate it like the cancers. They run their course moreover more rapidly than the former and have a tendency to break down, giving rise to a bleeding mass of tissue which may be mistaken for a cancer. They are also local, and are rarely associated with any secondary glandular enlargement. They should be dealt with as adenomata and removed.

Hydatid cysts are found in the breasts, but are not common. Only one example has fallen into my hands, although I have seen two others in the practice of my colleagues. My own patient was a woman, æt. 30, who for five years had had a *painless globular swelling* in her left breast, and when I saw her it was as large as a cocoa-nut. I tapped the cyst and evacuated sixteen ounces of a clear non-albuminous fluid, and, as it was evidently the fluid of a hydatid, I made a free incision into the tumor and turned out a large acephalocyst; the patient made a good recovery.

Nævus, involving the whole mammary gland, may be met with. I have had under my care a splendid example in a girl, six years old, in which the whole organ was like a sponge and as large as half an orange.

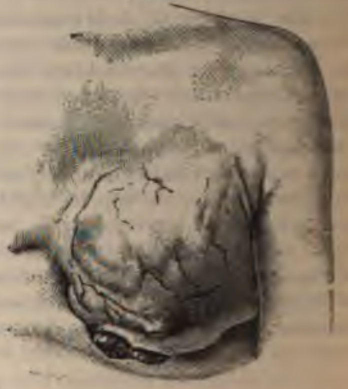
On the open, ulcerating, and discharging tumor of the breast.—In the growth of any tumor situated in the mammary gland or its neighborhood, there must be a period when the integuments will become so involved as to ulcerate or give way, and, under these circumstances, a discharging surface or cavity will present itself, varying in its aspect according to the innocency or malignancy of the growth with which it is associated. If the tumor is *cancerous* the open surface or discharging orifice will suggest its nature, and the integument itself or the margins of the wound will be infiltrated with cancerous material, the latter presenting the thickened, indurated, and everted margin so characteristic of the cancerous ulcer, and which, when once seen and appreciated, can hardly be mistaken (Fig. 405). But if the tumor be *innocent*, a very different condition will present itself, for a clear understanding of which it is essential to recall one or two points of difference between the innocent and malignant tumors, although attention may previously have been drawn to them in former pages. It is the peculiar nature of the innocent tumor to affect the part in which it is developed simply in a mechanical way; it may separate or displace, but never infiltrate tissues. On the other hand, it is the peculiar nature of the cancerous or malignant to infiltrate and involve every tissue with which it

Fig. 405.



Open cancer of breast, with infiltration of skin. Model, Guy's Mus.

Fig. 406.



Intra-cystic growth protruding through skin in case of simple cystic disease.

comes in contact. Applying, therefore, these two opposite features of the innocent and malignant tumors to the class of cases now under consideration, we shall readily understand how two very different local appearances may be produced; and how in the cystic cancerous disease, the wound or surface will be characterized by all the peculiarities of the cancerous ulcer, and in the cystic innocent tumor which may have ruptured from over distension, the margin of the wound or discharging cavity will look healthy, free from all appearance of infiltration, and rather as if mechanically cut or punched out than ulcerated. In the *cystic adenoceles* in which it is not uncommon to find a sprouting and discharging intra-cystic growth protruding from a wound through the ruptured integument, and presenting a very doubtful and sometimes cancerous aspect, the importance of this symptom cannot be overrated, for if found projecting through an orifice of the integument which is uninfiltrated and apparently healthy such as we have already described, the innocent nature of the tumor may with some confidence be declared (Fig. 406).

ON THE VALUE OF THE RETRACTED NIPPLE AS A SYMPTOM IN TUMORS OF THE BREAST.

There can be little doubt that as a positive indication of cancerous disease, the importance of a retracted nipple has been considerably overrated; and that, although the symptom may be common in infiltrating cancer of the breast, such a disease may exist without it; it may be present, moreover, in simple non-cancerous affections. For a retracted nipple may be regarded as an accidental symptom in the development of a tumor, as well as the product of mechanical causes, its presence being determined rather by the manner in which the gland is involved than by the nature of the disease. If any tumor, simple or malignant—any abscess, chronic or acute—attack the centre of the mammary gland, a retracted nipple in all probability will be produced; for as a disease so placed, necessarily causes material separation of the gland-ducts, their extremities, terminating in the nipple, will be drawn upon, and, as a consequence, a retracted nipple must follow. We thus find this symptom of frequent occurrence in the early stage of an infiltrating cancer of the organ, the nipple being always drawn towards the side of the gland which may be involved; while at a later stage, when the infiltration is more complete, the nipple may again project. In a central chronic abscess of the breast, the retracted nipple is equally common, and in the true cystic adenocele it may be also present. In the ordinary adenocele, whether cystic or otherwise, it is rarely met with, for the reason that this disease is not of the breast-gland itself, but only situated in its neighborhood. In rare cases, however, such an association may coexist, and in one case in which I observed it, some blow or injury had preceded the development of the adenoid tumor, and it was open to a doubt whether the retracted nipple had not been brought about by some chronic inflammatory condition. It should always be remembered, moreover, that a contracted nipple may be a natural condition.

On the value of a discharge from the nipple for diagnostic purposes.—When the discharge is slight or of a bloody nature, it does not indicate any special affection, though it is well known that in *cancerous* affections a discharge from the nipple is not unfrequent, the fluid having the appearance of blood-colored serum, which is never profuse, and rarely amounts to more than a few drops. In the *true cystic adenoceles*, this symptom is of considerable value, for in all the cases which have passed under my observation, as well as in the majority of recorded examples, this discharge from the nipple was a prominent symptom, the fluid being generally of a mucoid nature, and more or less blood-stained; and, although at times it occurred spontaneously and with relief to the patient, at others it could readily be induced by some slight pressure upon the parts. In the *ordinary adenoceles*, this symptom is seldom present. It exists, therefore, as a symptom in the true disease of the breast structure, whether cancerous or adenoid; and while slight and uncertain in the former, it is more general and copious in the latter; consequently as a means of diagnosis it is of some value.

ON CHRONIC DISEASE OF THE MAMMARY AREOLA PRECEDING CANCER.

Sir J. Paget has recently pointed out ('St. Barthol. Hosp. Reps.,' vol. x, 1874), what my own experience confirms, that cancer of the breast is sometimes preceded by a chronic skin disease of the nipple and areola; the disease in the majority of the fifteen cases in which he had observed it having "the appearance of a florid, intensely red, raw surface, very finely granular, as if nearly the whole thickness of the epidermis were removed;

like the surface of very acute diffused eczema, or like that of an acute balanitis. From such a surface there was always copious, clear, yellowish, viscid exudation." In some cases, the eruption has presented the characters of an ordinary chronic eczema or psoriasis, the eruption spreading beyond the areola in widening circles, or with scattered blotches of redness covering nearly the whole breast.

"The eruption has resisted all treatment, both local and general, and has continued even after the affected part of the skin has been involved in the cancerous disease."

"The cancer has always been in the substance of the mammary gland, beneath or not far from the diseased skin, and always with a clear interval of apparently healthy tissue."

Mr. Henry Butlin has also shown, that these changes are due to an extension of the disease from the surface of the nipple to the smaller ducts and acini of the gland, these parts being found filled on microscopical examination with proliferating epithelium which at times escapes from the ducts by rupture or growth into the surrounding tissues—thereby producing the full formation of carcinoma ('Roy. Med.-Chir. Trans.,' January, 1877), the mechanical retention of the epithelial element within the gland and ducts evidently playing an important part in the progress of this disease. Under these circumstances, it is wise where collections of epidermis collect upon the nipples to follow "Busch's practice in cases of epithelioma and remove them by the application of a lotion of soda from 3 to 6 grains to an ounce."

ON THE IMPORTANCE OF ENLARGEMENT OF THE ABSORBENT GLANDS AS A DIAGNOSTIC SYMPTOM.

When some enlargement of the axillary or clavicular glands exists with a chronic tumor of the breast, the malignant nature of the disease is rendered probable; for the simple adenomata are generally unattended by such a complication, and with the cystic affections it is also rare. Many months, however, may elapse in cases of cancer of the breast before the appearance of this symptom, because enlargement of the absorbent glands and infiltration of the skin have some connection.

In cancerous affections, the enlargement of the glands is indolent and very painless. In the inflammatory affections of the organ, glandular enlargement and tenderness are commonly present.

ON THE VALUE OF THE TUBERCULAR AND GENERAL INFILTRATION OF THE INTEGUMENT OVER THE BREAST.

When the integument of a breast is sparsely or thickly studded with shot or pealike tubercular infiltrations, or is so infiltrated with new material as to present a brawn-like feel and aspect, there can be no question as to the cancerous nature of the disease, since such a symptom is never present in any inflammatory or simple disease of the mammary gland. The infiltration may be slight, from the mere shot- or pea-like affection of the skin, to its more brawny infiltration; but in all stages it is equally characteristic, and speaks in positive language of the cancerous nature of the mammary growth, one tubercle telling as plain a tale as if many tubercles existed.

Cachexia.—I have no belief in the existence of a special cancerous cachexia. A cachexia may be present in cancer as in any exhausting or wasting disease; but that of cancer differs in no single point from that of any other affection. When a cachexia exists, it indicates the presence of some affection which is undermining the patient's strength, which may be cancer, but, it may be any other form of disease.

ON EXCISION OF THE BREAST.

There is no great danger attending excision of the breast beyond that which accompanies any, even the smallest, operation. It is true that patients occasionally sink after the operation from pyæmia, erysipelas, or visceral diseases, but these contingencies attend any operation for wound; from the excision itself there is little danger to life. From my notes of 133 cases of cancer in which excision was carried out I find that nine died, or about 6.7 per cent., while in three only, or 2.2 per cent., could the death be ascribed to the operation. One died from pyæmia, on the thirty-fifth day; one from erysipelas, contracted several months after the operation, when the wound had healed; two from acute bronchitis, three weeks and a month respectively after the excision; one from profuse diarrhœa, on the eighth day, probably pyæmic; one from hæmoptysis in the third week;

two from exhaustion after a return of the growth, in three and six months; and one from actual sinking after the operation on the third day. The three cases which died from pyæmia and diarrhœa which was also probably pyæmic, and the one which sank on the third day may, perhaps, with justice be directly assigned to the operation, but the fatal termination in the remaining six examples had no reference whatever to the excision. In the operations for innocent tumors of the breast, no fatal instance occurred. In operating for cancer, it is unquestionably the wisest course, as a rule, to excise the whole gland; when the tumor is, however, very local, the rule may be broken through, and it is as well not to be over-anxious about preserving too much integument, for if any doubt exists as to its perfect healthiness, the suspected portion had better be excised. When enlarged glands exist, it is wise to take them away. It is always important, when dissecting out the tumor, to keep clear of all diseased tissues, and, in fat subjects, to leave a fair covering between the incision and the tumor itself, as there is good reason to believe that an early return of the affection is too often to be explained by want of attention to these points. In several instances, I have found small cancerous nodules in the fascia over the pectoral muscle, which if left would have been the centre of new growths. In the operation for *adenocele*, it is quite exceptional for the removal of the breast to be necessary, and in the majority of instances, such a practice would be clearly unjustifiable. As a rule, the tumor is readily removed on making a clean section through its cyst-wall and enucleating the growth; the breast is rarely injured, even by the operation. In exceptional examples of this affection, however, it is absolutely necessary that the breast-gland should be excised, that is, where a large tumor is closely connected with it, as well as in the genuine or true cystic adenocele of the mammary gland. In the removal of a small tumor not involving the breast the best practice is to make the incision in a line radiating from the nipple, and to manipulate the parts as little as possible; the surest plan being to cut well into the tumor after having raised and made it prominent by grasping its base with the thumb and finger of the opposite hand.

The operation.—In the removal of a breast, the patient should be placed on her back with the shoulder of the affected side raised by a pillow and the arm drawn out at a right angle to the body. The incision should be elliptical and made in a line parallel with the fibres of the pectoral muscle, and, when the skin is diseased, it should be removed. The inner or sternal incision should then be made, and bleeding controlled by the pressure of the fingers of an assistant. The second incision may then follow, and should be made down to the free border of the pectoral muscle, the definite form of which is the best and surest guide to the base of the gland. The whole tumor by these means is thus readily excised, a few touches of the scalpel dissecting it off the pectoral muscle. The axillary angle of the tumor should be divided last, as it usually contains the chief vessels that supply the gland. All bleeding vessels should be twisted, the surface of the wound cleaned, its edges well adjusted, a drainage tube introduced at the most dependent part when the wound is large, and steady pressure applied by means of pads of lint, gauze, or cotton wool. *Adenoid* or innocent tumors should be excised only when they are steadily increasing, and are sources of trouble. *Cancerous* tumors should be removed as soon as the diagnosis of their existence is clear, for accumulated evidence tends to show, that the earlier a cancer is removed the better are the prospects of a complete or lengthened immunity from the disease, and that whether the disease returns soon or late, the best chance is thus afforded to the patient.

CHAPTER XXVII.

ON OVARIAN DISEASE AND OVARIOTOMY.

THE ovaries are glands, and are developed as other glands, being composed of like elements. In them during infancy and childhood, although cell growth and even cell shedding may go on, such processes take place silently, unattended by any external manifestations of their action. At puberty, however, when the ovum has matured and impregnation become impossible, external signs of these changes appear with menstruation, and with these changes, functional disturbances of the ovaries and parts connected with them occur, which may require the attention of the physician. The surgeon's aid is only called for when organic ovarian disease exists, and the nature of this aid varies with the nature of the case.

Ovarian disease is a somewhat common affection, and, although mostly met with during the active period of ovarian life, it occurs in childhood and mature age. Two specimens now in the College of Surgeons were taken from twin children five and eight weeks respectively by Dr. Leared, and a rare preparation at Prague shows a cyst in the ovary of a child a year old. Spencer Wells has recorded a successful case of ovariotomy in a child æt. eight, Dr. Barker, of Philadelphia, had another in one aged six years and eight months. I have recorded two cases in which girls, aged respectively fifteen and sixteen, sank after tapping from suppuration of the cyst; and in 1869 I published in the 'Guy's Hospital Reports' a case in which I successfully removed a polycystic ovarian tumor from a child aged fourteen, in whom no signs of puberty existed. But these instances are exceptional, and ovarian disease is essentially an affection of mature adult life.

Ovarian tumors may be clinically divided into four classes: *Monocystic*, or unilocular tumors; *polycystic*, or multilocular tumors; *dermoid* cysts, and *cancerous tumors*. The relative frequency of these different forms of tumors is well seen in the following conclusions that were drawn up after a careful examination of the records of 88 fatal cases of ovarian disease, extracted for me by the late Dr. Phillips from the Guy's Records, and copied from my work 'On Ovariotomy,' published in 1867.

Conclusions, *drawn from an analysis of* 88 *fatal cases of ovarian disease:—*

1. That 9 per cent. of the ovarian tumors are apparently monocystic; 9 per cent. dermoid; 18 per cent. cancerous, and the remaining 64 per cent. polycystic or compound.
2. That 53 per cent. of the cases are on the left side, 20 per cent. on the right, and only 17 per cent. double.
3. That simple cystic disease of the ovary is rarely double, and that, when double ovarian disease exists, the majority of the cases are cancerous, colloid, or of the solid kind.
4. That about 70 per cent. of the cases are in married women, and that the disease is most frequent between the age of twenty and forty, or during the vigor of sexual life.
5. That the disease runs its course in at least 75 per cent. of all cases within two years; 30 per cent. dying from exhaustion, 20 per cent. from peritonitis, 17 per cent. from suppuration of the cyst chiefly following tapping, 9 per cent. from the two last causes combined, 10 per cent. from peritonitis caused by rupture of the cyst, 10 per cent. from the cyst ulcerating into some viscus, such as the intestine or bladder. Hemorrhage into the abdomen and strangulation of the bowels by the pedicle caused death in 1 case in the 100.
6. That in the *monocystic* tumors there is a greater disposition for the cyst to ulcerate into the bowels than in other cases, and to suppurate after tapping.
7. That in 56 per cent. of the cases of cancerous disease, both organs are involved.
8. That in the dermoid tumors there is a greater disposition for the cyst to rupture than in all other forms of disease, death being directly due to this cause in 37 per cent.
9. That acute peritonitis and suppuration of the cyst as a direct result of the operation of tapping is by no means unfrequent.

Cases of *spontaneous recovery* occur, but they are so rare that they must not be looked for. When they occur they take place by rupture of the cyst, and this rupture is generally the result of accident or violent muscular action. As a rule, however, when a cyst ruptures, death takes place from shock, peritonitis, or blood poisoning (*vide* conclusion 5). In exceptional cases, when the cyst has discharged itself into the large intestine, the event may be signified by a copious discharge of the cyst's contents by the rectum; but when into the small, no such event may occur, the fluid being reabsorbed. Under both circumstances, there is always great danger to life from the entrance into the cyst itself of fecal matter or fetid air.

Diagnosis of an Ovarian Tumor.

When an ovarian tumor has attained a considerable size, has risen well out of the pelvis, and is unassociated with any complications, its diagnosis is not difficult, as a rule, more particularly if it can be made out to be composed of many cysts or multilocular. But when the tumor is small or very large; unilocular or very solid; central or of rapid growth, difficulties of diagnosis are met with, and it may be admitted at once that under any of these circumstances, there are few surgical cases that demand more care on the part of the surgeon before he gives an opinion, and still more caution before he acts upon it. In some few instances, indeed, a positive diagnosis cannot be made without the help of some exploratory operative proceeding. Under all circumstances, however, "in the diagnosis of a suspected ovarian case, every possibility of its nature should be entertained, and a conclusion arrived at by a process of exclusion; each possibility should be separately considered and weighed, and the most probable finally accepted."

The possibility of a solid or semi-solid tumor being due to pregnancy, and the probability of a cystic tumor being complicated with it or hydramnion ought always to be before the mind of the surgeon, while the complete cessation of the menses for a few months in connection with the existence of an abdominal tumor ought also to suggest caution in diagnosis, and, when for diagnostic or curative ends operative measures are being considered, delay, since though catamenial irregularity is common in ovarian disease, total arrest for any time is rare.

The early history of an ovarian case is always obscure, and the statements of patients concerning its early growth must be accepted with caution. In a general way, the tumor is discovered by accident, or, attention is first drawn to its presence by abdominal enlargement.

Pain is rarely present in the early stage of the disease, and when it exists is usually the result of mechanical causes; that is, it is due to the impaction of a small ovarian tumor in the pelvis, or to the pressure of a larger one upon the viscera, vessels, or nerves.

When the tumor presses upon the bladder, incontinence of urine or dysuria will occur; but when it irritates the bowels, diarrhœa. When it drags upon the omentum or presses upon the stomach, nausea and vomiting may be present, and where it encroaches upon the thorax, dyspnœa. Nerve pains will be produced according to the nerves that are pressed upon, and œdema of the genitals, legs, or abdomen, according to the amount of interference to the return of venous blood caused by the tumor. Œdema of the abdominal walls is said to be typical of cancerous disease of the ovaries, but this is not the case, since I have seen this symptom very frequently in undoubted examples of simple ovarian disease.

Local pain, pyrexia, with a high temperature and abdominal tenderness associated with a cystic abdominal tumor, generally indicate inflammatory changes within an ovarian cyst.

Dermoid tumors are said to be more commonly attended with pain than any other, and unilocular cysts with less, though I cannot confirm the former observation.

In well-marked examples of ovarian disease the face becomes pinched and the peculiar "ovarian expression" manifests itself, but after the removal of the tumor by ovariotomy, it is remarkable how soon this expression disappears.

The *differential diagnosis* of an ovarian tumor will now occupy our attention, and its physical signs will be first considered as made out by percussion and palpation, since it is by these more than any others that the surgeon is generally led to an approximate opinion of the nature of the case. Too much confidence, however, must not be placed on them, since they are only of value when taken in connection with other symptoms.

In all cases of suspected ovarian disease, the patient to be examined should be undressed and then placed on her back. The surgeon should afterwards so expose the abdomen as to be able to have a good look at it and observe whether the abdominal enlargement is central or lateral, smooth, irregular, or nodular in outline; he should view it also for a sufficient time to satisfy himself that the outline is stationary and that it does not shift. He should then place his hand flat upon the abdomen, and having rested it there for a minute or so to test the points just alluded to, move it steadily over the whole surface of the tumor in all directions, and, at the same time by palpation, ascertain something of the condition of the deeper parts.

By these means, much will have been ascertained as to the nature of the case. It will have been made out whether a tumor exists or not: something will have been learnt, too, concerning its size and mobility, and whether it is solid, fluid, or the two combined.

The surgeon should then proceed to percuss the parts, doing this at first superficially and then deeply. He should also examine for fluctuation; asking himself during the whole examination the following questions—Is this abdominal enlargement due to tympanitic or some phantom—that is, muscular—tumor? Is it due to, or complicated with pregnancy, or is it uterine or ovarian disease? Can it be a hydatid, renal cyst, or an enlarged viscus such as spleen or kidney? Is it a cancerous tumor?

A fluctuating tumor rising from the pelvis in a central position yielding a dull note on superficial as well as on deep percussion, with epigastric and lumbar resonance, is probably a cystic ovarian growth, and, when the tumor fluctuates in all directions, as is proved by the peculiar thrill of the wave elicited on percussion, the growth is probably *unilocular* or monocystic. When the tumor has an irregular or botryoidal outline, and fluctuation is confined to parts, it is certainly *compound*, the degrees of solidity in a compound or multilocular tumor varying greatly. If the tumor seem to be a unilocular or monocystic growth, the surgeon must remember that ovarian tumors of this kind are comparatively rare, and that those which appear to be such often contain some intracystic growths. He should also know that purely unilocular cysts are probably broad ligament cysts or parovarian, that is, a cystic degeneration of the tubules of the Wolffian body, although multilocular parovarian tumors have been recorded.

If the tumor be clearly cystic and multilocular, the probabilities are that it is ovarian, and if more solid than cystic, uterine.

Uterine and ovarian tumors yield a dull note on deep percussion, and, as in these cases the intestines are pushed upwards and towards the loins, these regions are consequently resonant, and no alteration in the position of the patient will alter this fact. In ascites, with the shoulders of the patient raised, the lower portion of the abdomen may likewise yield a dull sound, but with the shoulders depressed and the hips raised, resonance will be made out, the bowels naturally floating on the surface of the ascitic liquid. In ascites, the central portion of the abdomen is resonant and the sides dull, whereas in ovarian dropsy it is the reverse.

When the intestines, however, are matted together from cancerous or old peritoneal disease, difficulties occur, and errors in diagnosis can only be avoided by going carefully into the clinical history of the case and by a pelvic examination.

In ovarian disease a friction sound may be detected at times on auscultation or on the application of the hand, while in ascites no such symptom will be present.

ON THE DIAGNOSTIC VALUE OF A PELVIC EXAMINATION IN OVARIAN DISEASE.

The diagnosis of an ovarian tumor can hardly ever be said to be complete until a pelvic examination by means of the finger and uterine sound has been made, and the combined examination between the abdominal wall and rectum, for which purpose the patient had better be placed on her side.

When the uterus is found to be in front of and distinct from the abdominal tumor and movable without it, the growth is probably ovarian.

When the tumor and uterus move together, or if the uterus be drawn up out of the pelvis, difficulties in diagnosis may be experienced. If the tumor be cystic, it may be ovarian with a short pedicle, a broad ligament or parovarian cyst, or a cystic disease of the uterus.

When it is solid, it may still be ovarian, dermoid, fibrous, or cancerous; or it may be a fibrous tumor of the uterus.

A fixed pelvic tumor is probably neither ovarian nor uterine, but if either, it is cancerous.

In an ovarian tumor, the uterine sound will rarely go beyond its two inches, unless complicated with pregnancy or some uterine disease. In cystic disease of the uterus, it may enter for six or more.

The uterine sound should not be used too hastily for diagnostic purposes, because when pregnancy and ovarian disease are combined, evil may follow its use, although it ought always to be employed before operative measures are resorted to.

When ascites is present, a pelvic examination will generally detect a vaginal rectocele, that is, a bulging into the vagina of the posterior wall of the vaginal passage from the pressure of the ascitic fluid into Douglas's pouch, and this bulging is not met with in uncomplicated ovarian disease, though it may occur when ovarian disease and ascites coexist. I have found this point of great diagnostic value for many years, and was pleased to read that Dr. Peaslee had mentioned it as one of value.

"Solid uterine tumors," writes Tait, "besides the absence of fluctuation, have in addition two vascular signs which I have never met with in ovarian tumors, viz., an aortic impulse which may be seen and felt, and an enlargement of the uterine arteries to be felt in the vagina."

In pregnancy there is also to be seen the peculiar purple livid condition of vagina which does not exist in other pelvic tumors, the changed appearance of the nipple, enlargement of the breasts, &c. &c.

I have often found the rectal digital examination for diagnostic purposes to be great, and particularly in young or old virgins; but I cannot speak from personal experience of the value of the introduction of the hand. Professor Simon, of Heidelberg, however, speaks highly of it.

On the Value of Tapping for Diagnostic Purposes.

When there is any doubt as to the true nature of a cystic abdominal tumor, a preliminary tapping ought to be performed, and the physical nature of the fluid examined, although an ovarian fluid in our present state of knowledge is not to be recognized by any definite physical or chemical characters. Drs. Washington Atlee and Peaslee, however, inform us that the fluid of an ovarian cyst may be distinguished from all fluids by the presence of a peculiar cell which they call the ovarian granule-cell, which is about the size of a pus-cell, round and full of granules, and Mr. Thornton has recently confirmed these observations ('Path. Soc.,' March 16th, 1875); adding, moreover, that large pear-shaped, round, or oval cells, containing a granular material with one or several large clear nuclei, with nucleoli and a number of transparent globules or vacuoles, are characteristic of malignant tumors.

When, from what appears to be a monocyst, the fluid drawn is clear, slightly opalescent, and limpid, of a low specific gravity, about 1005, and non-coagulable by heat or nitric acid, or if coagulable by heat the coagulum is redissolved upon the addition of boiling acetic acid, there is a strong reason to suspect that the tumor is a broad ligament or parovarian cyst, and, under such circumstances, there is good reason to hope, that either a cure may follow the operation of paracentesis, or, if not a cure, the lapse of a long interval of time before the repetition of the operation is called for. This fact was pointed out by the late Dr. F. Bird ('Med. Times,' July 19, 1851).

When the fluid drawn off is clearly albuminous, tenacious, dark, or light colored, when it is even watery and like that contained in the cysts last described, and is found microscopically to contain the compound cells or epithelial elements already referred to, the tumor is probably ovarian, and ought to be removed.

When the fluid drawn off is highly albuminous and coagulates spontaneously, the suspicion of the tumor being a fibro-cystic uterine one ought to be raised, though there is little doubt that the true diagnosis of a fibro-cystic uterine tumor from a polycystic ovarian can only be made out, in the majority of cases, by an exploratory incision, when the absence of the pearly appearance of the ovarian and the presence of the pinkish, vascular, and fleshy aspect of the fibro-cystic, is enough to excite the surgeon's suspicion of the uterine nature of the growth.

When pregnancy and well-developed ovarian disease coexists, tapping ought to be performed, though in cases where the operation is inadmissible, from the nature of the tumor, ovariotomy is a justifiable proceeding, Spencer Wells having performed the operation in nine cases during pregnancy, and in eight with success; it should, however, be undertaken before the fourth month (Obstet. Soc. MS., 1877). When the tumor is small it should be left alone.

The Treatment of Ovarian Disease.—In the treatment of ovarian disease, medicine is of little value and has no direct influence in arresting its progress. It does good only by improving the general condition of the subject. The operation of tapping in unilocular cysts is, however, often of great value, and at times essential. Injection of the cyst is only applicable to a small class of cases. Ovariotomy, in a general way, is the only radical cure.

John Hunter clearly realized the truth of this in 1787, when he said, "In the early stage of ovarian dropsy I would almost advise that they should be *removed entirely*, if the complaint can clearly be ascertained, as they otherwise will certainly kill the patient." He adds, however, that "*electricity* has been serviceable lately in diminishing the progress of the formation of the fluid in a patient I am acquainted with. How far it will be of further service I cannot say" (MS. lectures).

At the present day the operation of ovariotomy is an accepted one by the profession, and is as recognized and justifiable as any other grave operation. Surgeons and physicians differ only as to the class of cases in which it is applicable, and the period at which it should be performed.

British surgeons may probably claim the credit of having established this operation in spite of early difficulties and blind opposition, and the names of Lizars of Edinburgh, MacDowell of Kentucky, Jeaffreson of Framlingham, Walne, Fred. Bird, Lane, Morgan, Aston Key, Cooper, and Cæsar Hawkins, of London, must ever be remembered as amongst its earliest practical promoters. Charles Clay of Manchester, however, the first great ovariotomist in this country, Brown and particularly Spencer Wells of London, Keith of Edinburgh, Koeberle of Strasburg, Sköldberg of Stockholm, and Atlee of America, with Hutchinson, and possibly the present writer, have by successes fairly overcome all prejudices, and rendered the operation an established and accepted one. Without going into the details of statistics which are now no more needed in this than in other large operations, it may be confidently asserted, that the operation is not placed in too favorable a light when it is said to be successful in 2 out of every 3 cases, good, bad, and indifferent, and in at least 3 out of 4 selected cases. Mr. Spencer Wells informs us, as the result of his unrivalled experience, that, out of his 900 cases, 221, or 24·5 per cent., died, and T. Keith lost only 33 out of 200 cases ('Brit. Med. Journ.,' June 26, 1875).

Having thus decided that the operation of ovariotomy is justifiable under some circumstances, and desirable under others, it may be well to consider what those circumstances are, under which it should be undertaken, and what are the best cases adapted for its successful practice.

Are all examples of ovarian disease to be treated by extirpation? if not, which should be selected, and at what period of the progress of the disease should the operation be performed?

What cases are to be selected for operation?—The very statement of this question would seem to imply, that the operation of ovariotomy is not suitable in all cases of ovarian disease, and that there are some to which it is quite inapplicable, since choice implies selection, and, as a consequence, variety, which leads us to consider what are the different forms of ovarian disease? For surgical purposes it is sufficient to divide all cases into the *simple* and *compound* cysts, the former being composed of one cavity only, the latter of many, solid material being almost always present, though varying in amount.

In the simple or *monocystic* ovarian tumors when the diagnosis is clear, other plans of treatment than ovariotomy are, doubtless, open to the surgeon, and among these the treatment by injection of iodine, which in the hands of different men has had variable success stands foremost. M. Boinet says that out of forty-five patients suffering from this disease, thirty-one were cured, five had relapses, and nine died. Sir J. Simpson performed it in about twenty cases with good success, only one case dying; while Dr. Tyler Smith found that out of ten cases in which this practice was followed two only were satisfactory, and two died. Dr. West in eight cases had one cured.

Still, this plan of treatment is uncertain; it may cure in exceptional cases, and does not generally meet with much favor; but in the majority it does no good, and may even be followed by a fatal result. It is applicable only to simple cases of monocystic disease, and is quite inapplicable and useless in the multilocular tumor, and where much solid growth exists.

A similar ovarian cyst uncomplicated with the development of smallar cysts within its walls, and unassociated with any solid growth, is unquestionably a somewhat rare affection. Such cysts are, however, occasionally found, and examples have fallen under my own observation, but they are not common; the majority of cysts, even those which appear to be simple, possessing the remarkable power of reproducing other cysts within their walls, and being, as Sir James Paget originally described them, proliferous cysts. The majority of the pure unilocular cysts are broad ligament cysts or parovarian, and in them a cure occasionally follows a simple tapping.

Among the cases which have been tabulated as monocystic tumors—only nine per cent. of the whole number—many doubtless were of the proliferous kind, and in these, the treatment by injection is not to be advised.

The treatment by iodine injection should, however, always be entertained by the surgeon in every case of apparent monocystic ovarian disease, while the circumstances of each individual case can alone determine what course ought to be taken.

Of the *fibrous* or *solid* tumors of the ovary, little need be said, as they seldom develop to any size or interfere to any great extent with the patient's comfort, while the expediency of their removal has rarely to be entertained by the surgeon. Should they, however, become cumbersome by their size, the expediency of their removal must be entertained, and decided upon as in other cases.

In all other forms of ovarian disease, in the *multilocular* or *polycystic*, composite, adenoid, or cysto-sarcomatous, as they have been variously called; in all which are made up of many cysts and of a variable quantity of solid material, such cases forming, indeed, the bulk of those coming under observation; there is no treatment which appears to be of any material benefit, none which seems to have any influence in retarding the growth of the disease, in palliating its inconveniences, or averting its end. The treatment by iodine injection is obviously inapplicable to them, and there is nothing else which offers any prospect of doing permanent good. The patient must quietly submit to her fate or to the alternative of an operation; and in these bearing "the stamp of incurability upon them," the question becomes necessarily narrowed.

By means of the operation of tapping, a patient may obtain relief, which is only temporary. Within a brief period, and at uncertain intervals the operation will have to be repeated, and, by repetition of such means, existence may be prolonged, but in the majority of cases, this prolonged existence is miserable, and the intervals of so-called ease are, at the best, uncertain. Tapping is also at times a fatal operation, in rare instances from hemorrhage into the abdomen, but more frequently from acute peritonitis and suppuration of the cyst. My own statistics prove, that these causes of death are 35·5 per cent. more frequent when tapping has been employed than when the disease has been allowed to run its course.

It should be observed, also, that in all cases of tapping, parietal if not visceral adhesions are prone to take place, and, in the analysis of fatal cases, this fact is well demonstrated. Under these circumstances, is tapping to be recommended in such cases of ovarian disease as appear to be favorable examples for the operation of ovariotomy? Without doubt, in the majority of cases, tapping had better not be performed. For *diagnostic* purposes, as already shown, it may be employed with confidence and with good effect, for it is better to run the risk of causing the formation of adhesions and even of death by the operation of tapping, than to submit a patient to the dangers of ovariotomy when the nature of the case is not clearly understood, and the propriety of the removal of the growth is surrounded with doubt. In very chronic cases, it may also be adopted when the tumor is made up of one large cyst, which may be a broad ligament cyst, and therefore curable by tapping, but, under other circumstances, it is by no means advisable to have recourse to the practice. Mr. Spencer Wells assures us, however, that the mortality of ovariotomy is but little affected by tapping.

When a patient has attained the point at which it is evident something must be done for her relief, the diagnosis of the disease is clear, and there are no points in the case contra-indicating the capital operation of ovariotomy, it is the safer practice by far to operate at once than to lose time, which may be of value, or to risk causing the formation of adhesions, which are always evils, by any such temporizing means as tapping. For diagnostic purposes, in certain cases, the operation of paracentesis abdominis is of great value, as it is in others in which relief is a necessity and the operation of ovariotomy is inexpedient or inapplicable; but, under other circumstances, it is a mistake and should be avoided.

Are all cases, therefore, of polycystic tumors of the ovary to be excised; and, if not, which should be rejected? It has been already shown, that there is no hope of doing permanent good to a patient laboring under this disease by any special treatment, as there is no remedy which can be trusted to retard the growth of the tumor, or to arrest its progress. Further, there is no operation less than that of extirpation, which offers any prospect of affording permanent relief, or benefit. Still, there are forms of multilocular ovarian disease with which it would be unwise to interfere, and others with which it would be quite unjustifiable, and among these the cancerous stand pre-eminent; and, though there may be difficulty in forming an exact diagnosis as to the existence of such a cancerous growth, an approach to certainty may be made and a fair probability attained. It is not, however, to be made out by any local examination alone, for, so far as my own experience goes, there are no definite local symptoms by which a solid or semisolid multilocular cancerous ovarian tumor can be diagnosed from one of a benign character, although, perhaps, in rare examples of cancerous disease the general outlines of the growth are more irregular or nodular. The suspicion of its cancerous nature is only to be roused by the general condition of the patient, and the natural history of the case; since in the cancerous, there will be, as a rule, more emaciation, wasting, and rapid constitutional decay than in the benign, and the disease will run its course more rapidly, although the size of the tumor may not be so great as in the cystic form. This rule has many exceptions, for the cancerous tumor of the ovary is very commonly a cystic disease, and there are no reasons why these cysts should not enlarge as much in the malignant as in the simple form, and in practice this is found to be the case. When solid and uncomplicated with cysts, the cancerous tumors, however, rarely attain a great size. It has been said that the œdema of the abdominal walls may be looked upon as a useful guide to indicate the cancerous nature of ovarian disease, but my own personal experience does not support this view, and in the instances which have come under my observation in which this symptom has existed to the greatest extent and the most marked degree, there has been little doubt as to the benign nature of the disease, for the tumors in one case had existed for eight years, in another for twelve, while in a third for at least thirty years, and in these three extreme examples, the thickness of œdematous integument over the lower part of the abdomen might have been calculated by inches—the œdema of the skin showing itself in vesicular swellings, varying from that of a pea to a large grape. The œdema was, indeed, so great that in all these cases tapping in the median line of the abdomen, or in front, was out of the question, and a lateral position had to be selected. If, however, the organs are found to be somewhat fixed and immovable on a pelvic examination instead of being free and mobile, the probability of the growth being of a cancerous nature is much increased, for the disposition to cause infiltration of the neighboring parts is as common in cancer of the ovary as of other parts. Cancer of the ovary is also apt to involve both organs, and from my notes of fourteen examples of disease of both ovaries, nine were cancerous; and among the cancerous there were only seven examples, or 43 per cent., in which the disease was single—the law of symmetry being observed in this as in other forms of constitutional disease. Under these circumstances, a careful pelvic examination is a matter of such great importance that under no conditions should it be omitted, since by it alone are these points in a large proportion of cases to be made out.

Are all cases of benign multilocular ovarian tumors, then, to be excised?—The answer to this question is not doubtful since the patient must be left alone to bear the inconvenience of the ovarian tumor, and endure the living death of its matured miseries and die, worn out and exhausted by the prolonged suffering produced by its presence; or, at some time in the progress of the disease, run the risk of the capital operation and submit to ovariotomy.

Before proceeding to consider the period of the tumor's growth at which it is desirable to undertake its extirpation, it will be well to look back on the natural history of the disease, and inquire, what are the chances of life for a patient who is left alone?—how long may life be prolonged under favorable circumstances? and, what is the average period in which ovarian disease runs its course?

In discussing these points, it is needless to quote numerous authorities, as all are tolerably agreed that the average duration of life of those who are the subjects of ovarian tumors when the disease is allowed to run its course, is two or at the utmost three years; that few live over four, and those who survive beyond that period must be regarded as exceptional. In my own cases 75 per cent. ran their course within two years.

"Taking everything into consideration," says Dr. Graily Hewitt, in his admirable work on the diseases of women, "we shall not be far wrong in drawing from the published cases of Dr. Lee and Mr. Stafford Lee the conclusion that the probable duration of a case of ovarian disease of progressive character is, in 85 or 90 per cent. of the cases, two or at the most three years; of the apparently 'stationary,' or chronic cases, the progress is more favorable, but in such cases the disease is liable at any moment to start into fresh activity. The first question we naturally put to ourselves when a case of the kind comes before us for decision is, Does this case belong to the fortunate series, the 10 or 15 in the 100? or is it one of the 90 who must die in the course of two or three years if unrelieved?" To the surgeon, however, this question is not of so much importance, for it is not till the tumor has become by its growth so large as to raise the question of operative interference that the answer has to be given, and at such a stage of the disease this becomes of little value.

Having thus clear ideas on such an important point, we may ask ourselves at what period of the tumor's growth should the operation of ovariotomy be entertained? I have no hesitation in answering this question, as the operation should not be entertained when the tumor is small, and causing little or no mechanical inconvenience, or, when the patient is in sound health and well able to perform all the duties of life or enjoy its pleasures. Ovariotomy should not be thought of when the patient's general condition of health is very bad or the powers feeble; when there is evidence of disease in any other organ than the ovary, and it is tolerably evident that the powers of life are unable to withstand the shock of operation, or incapable of rendering the needful reparative assistance for the recovery of the case. It is no more to be entertained under these circumstances than would any other capital operation; since the principles which guide the surgeon in the ordinary conduct of his cases, and which should scrupulously be adhered to in the practice of all operations, are applicable to ovarian disease.

It is true that a surgeon is sometimes led to perform an operation in neglected hernia, certain examples of amputation for disease or accident, in the ligature of a vessel, or the excision of a tumor when suffering is severe, and, if the patient be left alone, death is certain, although the probability of saving life is almost *nil*. Still, it is in exceptional examples of disease or injury that such operations are performed, and only when there is a possibility of success being obtained by an operation, and none without. Under like circumstances, a surgeon may be called upon to perform ovariotomy; when a patient is evidently being worn out by the disease, and by it alone; when life's tortures are evidently becoming unbearable, and death can be calmly looked at and even wished for; when there is even a bare possibility that, on the removal of the local disease which is clearly destroying life, the powers of the patient may rally, and that at any rate relief to the suffering will be secured; under such conditions, an operation may be admissible. With the aid of chloroform, the operation is rendered painless, and it is certainly true that the after-pains are, as a rule, marvelously little, for I have heard patients frequently say, that the pains after the operation are not severe. Under certain circumstances, consequently, the surgeon may be justified in performing ovariotomy with the object of giving relief, and when only a bare possibility exists of doing more, in the same way that he may be justified in doing any other operation, with the same object and a like slender hope.

When evidence or even a suspicion exists that the condition of the patient is due to some disorganizing change in the cyst itself, or some suppuration, the operation should be hastened. To wait is to allow the patient to die, for any improvement in the general condition is impossible so long as the local cause of the symptoms remains. The existence of an inflamed or suppurating ovarian cyst ought to be an argument for the surgeon to operate rather than the reverse. This condition should be suspected when fixed local pain or tenderness, constitutional disturbance, fever, a quick pulse, and a permanently high temperature are found; when, in fact, the general condition of the patient is such as to satisfy the surgeon that some local source of irritation exists.

I have hitherto briefly explained when the operation is not to be undertaken, and shown when it may perhaps be justifiable in extreme cases, but the surgeon should watch himself carefully in such desperate cases, and not be led to undertake it without much anxious thought and earnest consideration, since operations undertaken with no reasonable prospect of success are plainly unjustifiable, unscientific, and inhumane—they degrade the surgeon and injure the profession. The public derives no benefit from the experiment, and the character of operative surgery necessarily suffers. It is well, therefore, to bear in mind the sarcasm of Cruveilhier, that "even success does not always justify rash enterprises."

To return to our original point, let us inquire into the circumstances under which the operation of ovariotomy should be performed in the majority of cases, and, after what has been written, the answer to this question can hardly be regarded as difficult. For, if the reasons already given for the rejection of the operation are to be regarded as correct, it is tolerably clear, that it is to be thought of only when the tumor has, by its size, become so cumbersome as to interfere with the comfort and curtail the power of the patient to perform the duties and enjoy the pleasures of her ordinary existence; when the general health has become affected, and the local effects of the disease are distressing; under these circumstances, and these alone, the question of operation is to be considered, and, if permissible, to be undertaken.

Electrolysis.—If recent experience, however, is to be trusted, there is good reason to believe that the treatment by electrolysis is of value, for instances of its success have been published by Dr. Fieber, of Vienna, and Dr. Semeleder ('New York Med. Journ.,' June, 1876). A weak voltaic current was used by both doctors, and the needle attached to the positive pole was introduced into the tumor, whilst the other pole was applied to the skin with a sponge or metallic electrode. This treatment was employed daily from five to ten minutes, and cures were effected by from five to twelve weeks of treatment.

ON THE OPERATION OF OVARIOTOMY.

Before proceeding to consider the operation of ovariotomy, it may be well to inquire into the necessity of adopting any special treatment in the preliminary preparation of a patient who is to pass through such an ordeal; as some authors have led us to believe, that in this point of practice there is some special power, and that success or non-success in the ultimate result of this operation may be determined by the care with which the preliminary treatment has been carried out. For my own part, I confess that I have failed to recognize the necessity of adopting any such line of practice. The principles by which we should be guided in the preliminary treatment of a patient about to undergo the operation of ovariotomy, need not differ in any way from those which experience has taught us to be called for, previous to any other capital operation. We should do our best to raise the standard of health by all those general hygienic and other influences which are well known to act beneficially, such as good air, simple nutritious diet, a fair amount of stimulants, and the administration of some tonic. Let the patient take exercise when she can without pain, and be careful that it is kept within the limits of fatigue, that it be taken on level ground, and that no shaking or straining be on any account allowed; and, when she is at rest, the half-reclining position ought to be usually assumed. For a day or two before the operation, however, exercise, even when possible, is not to be advised, as quiet and repose are then of some essential service.

As a tonic medicine, iron appears to be of real and important value, having apparently an influence for good which other tonics do not possess. It is no more useful, however, before the operation of ovariotomy than any other capital operation, though it is as good, and I have often thought that in hospital practice wounds are less prone to inflame, and erysipelatous affections are less common under the influence of this medicine than when no such preliminary treatment has been adopted. In peritoneal operations, this point is of primary importance, and, as a consequence, the adoption of this practice should be recommended. The form of iron I prefer is the tincture of the perchloride, twenty drops of which, combined with a like quantity of spirits of chloroform or of syrup of lemons or tolu in water, forming a pleasant draught.

The bowels of the patient should be gently opened two days previously by such a mild aperient as castor oil, or a draught composed of ten grains of rhubarb and twenty of sulphate of potash in some aromatic water, and, on the morning of operation, the large intestine should be washed out with a warm water enema, but nothing like powerful purgation should be allowed under any consideration. Care should also be observed that the catamenial period has passed for at least a week previous to the operation, as all ovarian excitement is necessarily injurious at such a time, and should be avoided. I have known cases of ovariotomy, however, undertaken without any consideration of this point, and believe that under such circumstances an untoward result is to be expected.

In hospital practice the patient should as much as possible be isolated from all others and kept in a private room in which good ventilation exists; a special nurse should also be secured, who is not only entirely trustworthy, but understands how to use a female catheter. In private practice the patient's own house is the best for the operation, and country patients should not be brought into town unless an urgent necessity exists; as there is little doubt that the atmosphere of a large city is not so conducive to the rapid reparation of a wound as fresh country air. In abdominal surgery, this influence for good is of great value, and should not be thrown away unless from necessity.

The surgeon who is to operate as well as his assistant should not allow themselves, for a few days before the operation, to visit the post-mortem or dissecting room, nor should they handle any morbid preparations. Erysipelatous affections and all contagious diseases should also be shunned as much as possible; indeed, the same rules which are observed by the careful obstetric practitioner are necessary to the surgeon who undertakes the operation of ovariotomy; since the same subtle poisons which are recognized by all to be hurtful to the puerperal woman, act with equal force upon the subject of ovarian disease, when submitted to ovariotomy, and, as a consequence, should be studiously avoided. It follows, therefore, as regards the lookers-on at an operation, and all who may come in contact with the patient, that none who may bring infectious or contagious disease should on any account be admitted. The physician who is attending a case of puerperal fever is looked upon as a possible poisoner as far as concerns the puerperal woman. The medical attendant of a scarlet fever case, of erysipelas, or other contagious disease, should be regarded in the same light in the presence of an ovariotomy operation, and be excluded. Hence, in hospital practice, great care is needed to exclude all such possible means of injury as have been briefly enumerated.

I need hardly allude to the necessity of all bed and bedding, blankets, sheets, and hangings being perfectly fresh; all sponges being *new*, soft, well cleansed, scalded, and free from soap and grit; of flannel, when wanted, being fresh, and having been previously well washed in warm water; and every instrument to be employed being scrupulously clean. The hands of the operator should likewise be thoroughly cleansed from soap just previous to the operation, and be well warmed, for manipulation with a cold hand cannot but prove injurious to an exposed peritoneum. Dr. Peaslee considers this fear of irritation from the handling of the intestines and peritoneal membrane to be so great that he bathes his hands with a preparation which he calls an artificial serum, composed of water four pints, white of eggs six drachms, and salt four drachms. This practice, however, has not been followed by any other operator.

The temperature of the room in which the operation is performed.—There is still some difference of opinion on this point, among operating surgeons, Dr. Clay, of Manchester, Peaslee of America, and others, advising that the operating room be heated to 75° F. or 80° F., and a good supply of moisture engendered by the diffusion of steam, while Wells and others make no such rule. Speaking from my own experience, I have no faith in the adoption of such a practice. I would have the room heated to a comfortable temperature, 65 degrees being amply sufficient, since a greater heat acts as a powerful depressant upon the patient, and can do no good. A warm room with good ventilation is what I always seek in preference to a hot one, with closeness. A cold damp room under all circumstances is to be condemned.

The position of the patient.—The horizontal position is that which patients suffering from ovarian disease can rarely assume, and when the tumor is so large as to require ovariotomy, this becomes almost impossible. As a consequence, the half-reclining position is the most comfortable for the patient and convenient for the operating surgeon. It is the posture I have invariably adopted in the cases which have fallen into my hands, and I know of no good reason why it should be changed. Some operators have employed the sitting posture in preference to any other, on account of the facility with which the tumor can be removed through the abdominal incision, and also on account of the advantages it gives in preventing the escape of the ovarian cyst-contents into the abdominal cavity. Mr. Hutchinson, for the same reason, prefers the patient to be turned partially on her side, but both these postures are not only inconvenient to the operator, but have other real objections which forbid their recommendation. The chief objection is derived from the fact, that the same law of gravity which acts upon the tumor and its contents, facilitating its escape from the abdominal cavity, and allowing it to tumble out when the incision is made, acts as powerfully upon the abdominal viscera, and thus the disposition which always exists for the intestines to escape through the abdominal section is greatly increased, and the danger of excess of manipulation of these parts much aggravated; the difficulties of the operation, moreover, are increased. The tumor also may fall out too rapidly, and, by causing a too sudden and unexpected strain upon the pedicle, a severe and perhaps fatal rupture of some important part may follow. This evil is no slight one, and, as an argument against the practice, is of some force. Upon the whole, the advantages said to be gained by the side posture are thus counterbalanced, and, as I think, more than counterbalanced by disadvantages.

The half-sitting or semi-recumbent position affords all the advantages which have been claimed for the other postures to which I have alluded, without their evils; for in it the tumor can readily be removed from the abdominal cavity, and with care, its fluid contents can without difficulty be prevented from passing into the peritoneal cavity. There is also abundant room for every manipulative act that can be required.

The administration of anæsthetics in the operation and local anæsthesia.—Among the many incidental advantages which the introduction of anæsthetics has afforded beyond that of relieving pain, few are greater than that of obviating hurry, a point of critical importance in ovariotomy; and there can be little doubt, that the success of the operation has thus been greatly influenced by their use.

It is true that operations for the removal of an ovarian tumor were undertaken before the introduction of any anæsthetic, but we all know how fatal were their results, and exceptional was a recovery. Those who had an opportunity of witnessing the performance of an operation under such unfavorable circumstances can hardly wonder that so many patients succumbed to the practice, although they might be surprised that any were found to convalesce. To see a patient writhing under the agonies of an abdominal section was enough to make the hardest heart turn with horror, and to witness the surgeon's hands within the abdomen of a struggling woman, in his endeavor to remove an adherent growth, was almost sufficient to make any professional spectator decide that such an operation was really unjustifiable.

How, in such a case, was it possible for a surgeon to be quiet in all his movements, gentle in his manipulations, and thoughtful over the difficulties which of necessity present themselves in an ovarian operation, when the cries of the patient's agony stimulated him to expedition, and her struggles forbade gentleness? All surgeons who have operated upon these cases will agree, that success even under favorable circumstances is only to be acquired by attention to these points; that hurry in any operation is always bad and unjustifiable, while in ovariotomy it is destructive; that force is never to be employed in any case where art will answer; that in ovariotomy all blind force, and dragging is to be strongly condemned; and that in a proceeding in which steadiness in operating, gentleness in manipulating, and thoughtful attention to every detail are absolutely essential to success, the safety of the patient must depend upon her quietness and passiveness under the surgeon's treatment.

Under these circumstances the value of some anæsthetic cannot be too highly praised, for the patient by it is not only rendered insensible to pain, but her perfect quiescence is guaranteed, and her passiveness under the hands of the operating surgeon completely insured.

The vomiting that occasionally follows the use of an anæsthetic is the only argument against its use, but it is an evil which must be endured for a positive good. By the use of the nitrous oxide gas followed up by ether, or of the chloroform mixture, of alcohol one part, chloroform two, and ether three parts, as recommended by the Chloroform Committee of the Med.-Chir. Society, this vomiting is certainly less common than after the use of chloroform alone, and as a general anæsthetic it should be employed. Keith prefers ether, and Wells the bichloride of methylene for the same reason.

Extent of the incision into the abdominal parietes.—The temperature of the room, the position of the patient, and the propriety of the administration of chloroform having received our attention, the operation itself next claims consideration, and the first thought naturally is as to the extent of abdominal incision required, as there is still a want of unanimity in the practice of different surgeons upon this point.

Before commencing, the careful surgeon will see that the bladder has been emptied by means of a catheter; the linen of the patient well drawn up out of harm's way and free from the chance of becoming soiled by the use of waterproofing; the limbs of the patient well protected and kept warm by a pair of drawers, and covered by a clean sheet, either with or without a blanket. He should see also that all his assistants are carefully arranged, and special duties assigned to each, and that every instrument that may be required is clean and nigh at hand. He may then proceed to make his incision, the patient having been brought completely under the influence of an anæsthetic; though previously he should determine as to its length. From Mr. Walne, Sir J. Simpson, and Dr. Clay's practice it might be argued that the long incision should always be adopted, since their success has been great, and in their practice the long incision has been invariably employed. From the practice of Dr. Keith, Mr. Spencer Wells, and others, the short incision would appear to be the better, for their success has at least been as good as that of Dr. Clay and others, and as a rule the short incision has been the one selected. I regard the truth as between the two extremes. When the tumor can be removed with facility by means of a short incision, a long one is clearly not required; and, when the tumor is monocystic or nearly so and free from abdominal adhesions, it may be so removed. But when the tumor is large and semi-solid, or, when adhesions exist which cannot be readily broken down by the employment of gentle traction upon the growth, it is the best practice, doubtless, to make a long incision; as by so doing the removal of the growth is much facilitated, the causes of its abdominal retention and the connection of the adhesions are satisfactorily ascertained, and, as a consequence, can be dealt with with greater safety.

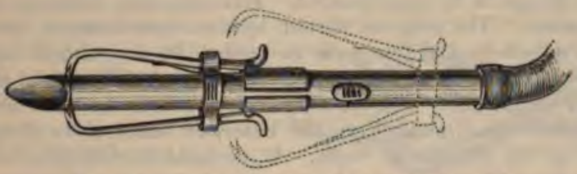
My own practice has hitherto been influenced by such a conviction; and I have in all cases commenced the operation by making a short abdominal incision, and, in many, have been enabled to remove the tumor without further trouble. But in certain examples in which difficulties appeared, and in which it was clear that adhesions existed, for the breaking down of which some force would have been required, and some working in the dark called for, I have been induced to increase the length of the wound upwards, even for an inch or two beyond the umbilicus, regarding such an increase of the incision as unimportant in comparison with the evil effects of violence, and dragging upon the tumor for the purpose of its removal, or the blind tearing down of the abdominal or visceral adhesions which have detained the growth.

I have never seen any evil effects from the long incision when made under the circumstances I have just indicated, but have, beyond doubt, seen the bad results of an opposite practice, of violence which has been employed in an attempt to remove a large growth through a small opening, or to tear an adherent one from its abdominal or visceral connections.

The incision should also always be made sufficiently low. If too high, considerable traction upon the pedicle of the tumor must made to bring it into sight, and, with the tumor, the uterus will also be drawn out. This traction is always injurious, and should be avoided. When the lower end of the wound is too high up, this traction of the parts becomes unavoidable; by extending the incision downwards towards the pubes to a point corresponding to the upper part of the healthy uterus or about one inch above the pubes, this evil can be prevented, and, consequently, the practice I have just advised should invariably be adopted.

On tapping the cyst.—The cyst, having been exposed, ought to be tapped, and for this purpose the instrument represented in Fig. 407, as made for me by Mr. Millikin, in 1864, is the one I prefer. It includes not only a trocar and canula but a vulsellum forceps, which slides upon the latter, and, by being made to grasp the cyst walls, holds the instrument firmly in its position, thus enabling the surgeon to make traction upon the tumor for the purposes of its removal.

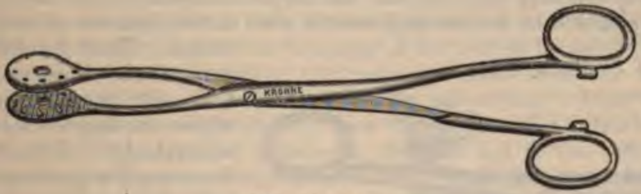
Fig. 407.



Trocar and canula for tapping with movable forceps.

When the cyst has been emptied and is of a simple nature, its removal, unless adhesions exist, is readily effected, but when it is solid or very compound it may be necessary, to allow of its extraction, to lessen its size by breaking down its contents, and for this purpose, the surgeon must make a free opening into the cyst and introduce his hand into its interior, the orifice of the opening into the cyst at the same time being held well open and forward by forceps (Fig. 408) adapted for the purpose. By these means, the most compound cyst may be broken down and removed. When the cyst is so adherent to the abdominal parietes as to render it difficult for the surgeon to distinguish the cyst-wall itself from the parietal layer of peritoneum, the plan adopted by Mr. Spencer Wells, of emptying the cyst and seizing its posterior or upper wall from within by forceps and inverting it, is a good one, the cyst then peeling off on good traction being made.

Fig. 408.



Nélaton's cyst forceps.

On adhesions and their treatment.—When the incision through the abdominal walls has been made, and the smooth glistening surface of the visceral peritoneal covering of the tumor recognized, the surgeon may be satisfied that the abdominal cavity has been fairly opened and the tumor exposed; and, when the ovarian cyst on each respiratory act is seen to move freely within the abdomen, there is a strong probability, if not certainty, that the tumor is free, and the complication of adhesion is not likely to be severe; for, when the tumor is fixed to the abdominal walls, this mobility of the cyst is not present; and fibrous or fibro-cystic tumors of the ovary or uterus usually have a fleshy or muscular appearance. It will be well, therefore, to consider how these adhesions are to be treated.

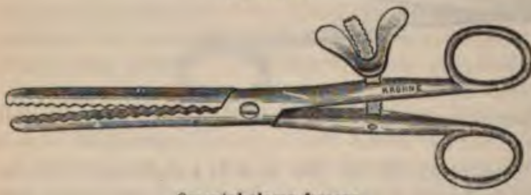
They may present themselves on the completion of the abdominal incision in two forms. *Firstly*, as forming a complete and compact union between the peritoneal covering of the cyst and the abdominal peritoneum; *secondly*, as loose and fibrous connective bands; and *thirdly*, as visceral adhesions.

When a firm and compact union exists between the cyst and the abdominal peritoneal membrane, the surgeon will have lost his chief guide as to the depth of his abdominal section, and, under these circumstances he may experience some difficulty in deciding whether the abdominal cavity has been opened or not; he must consequently be careful in his procedure, for he is not far from the possibility of perpetrating a fatal error—the separation of the parietal peritoneum from its muscular connections; but this error, however, can be avoided by merely extending the abdominal incision upwards, until the distinct line of separation between the cyst-wall and the abdominal peritoneal membrane is clearly seen. The next step of the operation consists in the breaking down of adhesions, which may be done by the careful introduction of the finger between the cyst-walls and the parietal layer of peritoneum. And here some force is perfectly justifiable, for if the adhesions are confined to the abdominal parietes and can be torn through, there is rarely much subsequent danger to be apprehended. Extreme care, however, is required at this stage of the operation. The surgeon should, by the introduction of his finger, make out the extent of the adhesions and test their strength. If they should be found numerous and too firm for separation, the operation, at this stage, had better be abandoned and the wound closed; or, should many visceral adhesions of a firm character be present, it would be well to follow the same practice, as the latter are much more dangerous than those merely attached to the abdominal walls. It is, indeed, difficult, if not impossible, to describe with anything like accuracy what extent or character of adhesions would justify the surgeon in abandoning an operation once begun and then closing a wound. The careful study of reported cases and experience alone, will enable him to decide with certainty upon these points. Yet, as a broad rule it may be asserted, that while parietal adhesions may be fearlessly treated when they can be divided, those connecting the cyst with the viscera and the pelvis should always be regarded with alarm; and that the amount of force permissible in the treatment of the former class of cases would be quite inexcusable when the viscera are concerned. Wells's method of emptying the parent cyst, passing one hand into its interior, grasping its back and inverting it, the back part of the cyst being withdrawn through the opening made in its front, is an excellent one.

The fear of hemorrhage from the lacerated adhesions should always be present to the surgeon, and the torn surface should be carefully examined with a view to the arrest of any bleeding.

Omental adhesions should be particularly examined with care and torn through with caution, for they are very vascular and cannot be treated with too much consideration. As a rule, they should be divided and secured with a fine ligature of silk or carbolized catgut. Their forcible separation is always bad. Spencer Wells's forceps (Fig. 409) for holding the omentum whilst the surgeon secures the vessels is invaluable. Firm band-like adhesions may be similarly treated. The ends of each ligature may be cut off and the knot left in.

FIG. 409.



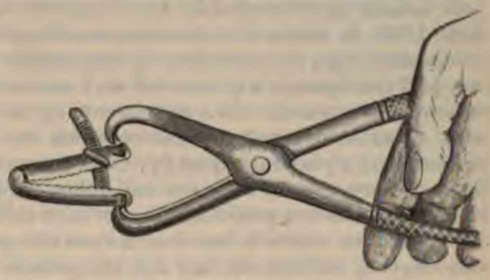
Omental clamp forceps.

When the incision has been made, and no evidence that adhesions exist between the cyst and the internal abdominal walls, it appears to be an unnecessary practice for the operator to introduce his hand into the abdominal cavity with the view of learning whether they exist or not. Adhesions in front must necessarily be broken down, which can generally be effected by the finger of the operator introduced at the margin of the wound; and, as the cyst empties, these adhesions are necessarily brought forward, but when they do *not* exist, the peritoneum escapes even the touch of the hands of the operator. In complicated and exceptional examples of this operation it is clear, that this practice cannot be followed, but in the more ordinary and simple cases it is most applicable. In many examples which have come into my hands, the value of this advice has been well proved, for in them the peritoneum was touched only by the knife and needle.

The treatment of the pedicle.—If there be one thing more than another in the practice of ovariotomy which presses for a solution, it is the treatment of the pedicle, for the practice of different surgeons on this point varies extremely, and the multiplicity of methods is most confusing. In France, Maisonneuve twisted off the cyst by continued torsion, leaving the pedicle to fall back into the abdomen; whilst Nélaton preferred to fix the pedicle externally, and secure it by means of a common clamp. In Germany, Martin and Langenbeck cut through the peritoneal covering of the pedicle by a circular incision, cut off the tumor, tied each vessel separately, and fixed the pedicle to the walls of the abdomen by means of a double ligature. Dr. C. Clay fastened the pedicle by a double ligature, cut off the tumor, and, having allowed the pedicle to drop backwards into the pelvis, brought the ends of his ligatures out through the lower ends of the incision.

Dr. Tyler Smith advised the same treatment of the pedicle as Dr. Clay, but differed from him in the important respect of dropping both pedicle and ligatures, which are cut off close, into the pelvis; the wound should then be closed. Mr. S. Wells prefers to fix the pedicle externally by means of a clamp (Fig. 410), and Dr. T. Keith has adopted the same practice, although recent experience has satisfied him of the value of the actual cautery as employed by Mr. B. Brown and Skölberg, who divided it by the actual cautery, and allowed it to drop back into the pelvis. Atlee of America employs the écraseur. In my own practice, I have not adopted one uniform method, having been influenced in my decision by the special peculiarities of each case.

Fig. 410.



Spencer Wells's clamp.

If we refer to the results of the practice of different operators, who have been in the habit of adopting the various plans to which I have alluded, it will be seen that good success has attended each. Upon the whole, the best results possibly have attended the practice of fixing the pedicle externally.

The first object which the surgeon has in view in the treatment of the pedicle is, to prevent hemorrhage, and, in the attainment of this end he should employ such means as are the least liable to excite or be followed by, peritoneal inflammation. When experience has decided upon a plan which will with certainty secure these two objects, the one great difficulty which attends the practice of ovariotomy will have been overcome, and the mortality of the operation, doubtless, be much diminished. In the infancy of ovariotomy the early operators treated the pedicle upon the simplest principles. They secured it by one or two ligatures and brought the ends of the ligatures out of the wound; but subsequent experience has taught us, that the fastening of the pedicle by one ligature is dangerous, and cannot be adopted with safety. It does not attain even the first object the surgeon ought to have in view, namely, security from hemorrhage; while the mortality of the cases in which it has been employed has been very great. The practice of fastening the pedicle by a double ligature, and of bringing the ends out of the wound, still exists, and in Dr. Clay's hands has proved successful.

The fear of exciting peritonitis by the presence of such a foreign body as a double ligature hanging from the wound, and the natural dread that surgeons entertained of evil consequences from the decomposition of the extremity of the ligatured pedicle within the pelvis, rendered the minds of surgeons dissatisfied with the practice just described, and induced Mr. Duffin to urge the expediency of keeping the strangulated stump of the pedicle outside the wound. Mr. Hutchinson perfected the practice by the introduction of the clamp. Up to a recent date, this practice was generally approved, and, as can be seen by the statistics of the different operators, it has hitherto borne good fruits; still, to the minds of reflective men, it was not so satisfactory as could be wished; the good which was evidently acquired by maintaining the secured pedicle external to the wound was neutralized in certain cases by an undoubted evil. When the pedicle was long and narrow, the method appeared to be good and successful; but when the pedicle was short or broad, many bad effects became perceptible—evils which could only be attributed to the traction upon the uterus and its appendages from their pelvic position. It was thus, therefore, that other plans of treatment were looked for, by which this traction on the pedicle could be obviated, and yet security from hemorrhage guaranteed.

The plan of treatment which naturally suggested itself was the dropping in of the pedicle with the divided ligature, and this was first done in 1829 by David Rodgers of New York, who, in removing an ovarian tumor, applied a ligature to the pedicle, cut short both extremities of the ligatures, returned the pedicle into the abdomen, and closed the external wound. His patient made a good recovery.

This plan of treatment did not meet with general approval. It was too bold and inconsistent with all past experience and professional prejudices, and fell to the ground. It was repeated at intervals by other surgeons with tolerable success, and has now gained a strong hold on the professional mind, and bids fair to become, in certain cases, a more general practice. I may mention here that Sir B. Brodie had some confidence in this practice, for in 1843, when discussing the case upon which Mr. Aston Key had operated without success, at Guy's Hospital, he expressed his belief, that the right treatment of the pedicle was to drop it in and close the wound, and that if success could be secured, it would be by such means. I make this statement on the authority of Dr. Oldham, who heard the remark.

In a fatal case recorded by Dr. Peaslee in the 'American Journal of Medical Sciences,' July, 1865, in which this practice was adopted and death followed the operation on the seventeenth day, the extremity of the pedicle was found to be atrophied, but not sloughing, and the ligature was covered with an exudation of lymph which had already become somewhat organized. In a case occurring in my own practice, the pedicle was secured with a carbolized catgut ligature which was cut short and dropped in, and when the patient died a year subsequently, from some other cause than the disease, no traces of the ligature were visible, nor even an adhesion, the fimbriated end of the divided pedicle being free. In our profession, however, a theory when once established rapidly develops, and a practice which is based on a received principle soon improves. The professional mind having realized the fact that the pedicle of an ovarian tumor might with safety be strangled by a ligature, dropped into the abdomen, and the wound closed; and, having been taught by the results of experience that the strangled extremity of the pedicle did neither decompose nor set up any peritoneal mischief, looked out for some other plan of treatment by which the presence of the foreign body, the ligature, might be done away with. As a result, the division of the pedicle by the écraseur was tried, while that by the actual cautery has been introduced. The use of the cautery is a bold practice, and has the advantage of past experience in its favor, since from the earliest times the hot iron has been a favorite means of arresting hemorrhage, even from large vessels. In the veterinary art it is also still constantly employed. Mr. Baker Brown, to whom the credit of its application is unquestionably due, informs us that his experience of this form of practice is very good, and that of Skölberg of Stockholm is certainly startling. But hemorrhage at times follows the practice and renders it uncertain. I have lost two patients from this cause.

On the whole, the evidence seems to indicate that the practice is good in certain cases—that in short, fleshy, and broad pedicles, the cautery is efficient, but that in the long and thin it is unnecessary, other treatment being more applicable. More facts, however, are required before the cautery can be generally received into practice, although by means of the cautery, aided by the crushing of the extremity of the pedicle, safety may be found even in extreme cases.

What, then, it may be asked, is the right treatment of the pedicle of an ovarian tumor? Is it always to be secured by one method? and if not, under what circumstances is the plan to vary?

Going back to past experience we have ascertained that if the pedicle is to be tied, it should be in at least two places; and that all traction on the pedicle, and as a consequence on the uterus, is to be regarded with apprehension, and, therefore, to be avoided. We have learnt that the pedicle may be ligatured in two or three parts, dropped back into the pelvis, and that the ends of the ligatures may be left hanging from the wound with a good result; and that the pedicle may also be fastened externally by means of a clamp with equal success. But we have also ascertained that good success is gained by dropping the pedicle into the abdomen, after its division by the crushing clamp and cautery, after it has been ligatured in two or more portions and the ends of the ligature been cut off.

It would appear, as far as present experience goes, that in the case of long pedicles, the best practice is to fix them externally by means of a clamp; with short and broad pedicles in which the vessels are usually small the cautery may be employed; or, the pedicles ligatured in two or more parts with stout silk, the ends of the ligatures cut off, the stump dropped in, and the wound afterwards closed.

If subsequent experience proves that the cautery is to be relied on, whether aided or not by other means, we shall doubtless have discovered a plan of treatment which bids fair to do more for ovariotomy than any other improvement of modern times. Hitherto it has been in the treatment of short and broad pedicles, the class of cases for which the actual cautery is now proposed, that ovariotomists have experienced so much difficulty; but at present the practice can hardly be said to have yet arrived at any state of certainty.

In this treatment of adhesions, our practice should be governed by like principles. When they are slight, they may be broken down; when strong, they may be divided or ligatured, or perhaps destroyed by the cautery. When large vessels exist, they must be tied until the crushing and cauterizing plan of treatment has been perfected. But let no risk be run, let the ligature be applied, and their ends cut off, rather than incur any chance of bleeding.

On sponging out the pelvis.—The tumor having been removed and the pedicle secured, it will be well to examine the opposite ovary, to be sure of its healthiness, and then to turn attention to the presence of the fluid or blood that may have escaped into the pelvis during the operation. If the fluid of the ovarian cyst has been of the serous kind, and the evidence of the extravasation of blood into the abdomen is purely negative, there will be little or no need of running the risk of irritating the peritoneum or pelvic organs by the application of a sponge; for the thin serous fluid of ovarian cysts is readily absorbed, and the presence of a little blood of small consequence, since we know from experience that blood may be extensively effused into a joint and no evil follow, as it may into the cellular tissue of a part and yet be absorbed. Obstetricians will also readily recall cases in which blood has been effused into the peritoneal cavity without, of necessity, any serious result. A sponge must not, therefore, be applied to the delicate surface of the peritoneum without good reason, and, where the fluid of the ovarian cyst has been simply serous, and no evidence of the effusion of blood in any quantity, there is no need to use a sponge. When required, it should be new, of the softest kind, and well warmed, two or more dips into the pelvis being carefully made, to free the cavity from all foreign matter. The sponge is far preferable to flannel, for, when properly cleansed and soft, it is quite unirritating, and not so likely as flannel to leave any foreign matter behind. The sponge, however, should always be carefully employed when there has been any escape of mucus or other thick ovarian fluid, and when much blood has been effused; indeed, in those cases, much care is required to cleanse the pelvis and abdominal cavity from all such irritating materials. The number of sponges and forceps employed should always be counted before and after the operations for obvious reasons.

Treatment of the wound.—The operation completed, the pelvis cleansed, the opposite ovary examined, and all signs of hemorrhage absent, the surgeon may then proceed to the closure of the wound. He should do this by means of deep and superficial sutures, and he may use silk or silver sutures according to fancy. In my early operations I preferred silver sutures which I have now discarded, as I do not find them less irritating than silk, and, in their removal, they are more liable to scratch and tear the tissues through which they are drawn than the fine white plait, sold by fishing-tackle makers, which I am now in the habit of employing. These sutures should be inserted at intervals of an inch, and include the muscles, and peritoneum; intermediate superficial sutures being inserted through the skin. When union has taken place, they should be removed, any time between three and six days being suitable. When repair has taken place, no object is gained by leaving them *in situ*; they are then foreign bodies, and should be removed.

Drainage-tubes.—In all complicated cases where the peritoneum has been much involved and there is a probability of hemorrhage or serous exudation, the introduction of a drainage tube at the lower angle of the wound should be followed. One made of glass is better than the india rubber.

The after-treatment.—Whenever a patient has taken chloroform or any anæsthetic mixture, it is wise to keep the stomach as quiet as possible, and as the benefit of an opiate after the operation is always great, it is wise to administer it by the rectum. In abdominal operations, this practice is of great value, and, for some years, I have been accustomed to give a half grain of morphia suppository after every ovarian operation, as well as after others of hernia, ruptured perineum, &c. The suppository should be administered before the patient has recovered from the effects of the anæsthetic, and care should be taken that it be passed well into the rectum. If pain appear, the suppository may be repeated, but it is rarely necessary to administer it more than once a day, at bedtime. The patient's room should be kept cool and airy, as in other cases of operation. For the first two days, milk or barley water form generally the chief diet; but should sickness supervene as a result of chloroform, ice and milk, or ice and soda water should be administered; and everything should be cold. If it continues, food ought to be given two or three times a day by the rectum. As soon as the stomach will admit, fresh meat, brandy, and wine ought carefully to be given, the object being in these cases, as in all others of general surgery, after the first three days, to keep up the powers of the patient, and so enable nature to complete the cure. The application of an ice bag to the abdomen I have found of great advantage, and an ice cap to the head when the temperature rises. The urine ought to be drawn off periodically by the catheter, and when the bowels require relief, their action should be rendered easy by the use of enemata. The bladder should never be allowed to become distended, nor the bowels be left loaded too long.

On the use of opium a few remarks remain to be made, for upon this point the practice of surgeons appears to be undergoing a change. In the early operations of ovariotomy it was extensively employed, and at the present time, some are still free with its use, but there is good reason to believe, that in this operation as in others, a very free administration of the drug in every case is not attended by such good results as could be wished; and that in a patient under its full influence, a wound does not repair so rapidly and favorably as in another where natural processes are allowed to progress without interference. Opium carefully given to allay pain and cause sleep, is a drug upon the value of which there cannot be a doubt, but opium administered with sufficient freedom to bring, and repeated often enough to maintain, a patient under its influence, is a drug the use of which a surgeon should be on his guard. In ovarian cases it ought not to be given in larger quantities than sufficient to allay pain and secure sleep. A patient should not be kept under its full influence, unless there are specific reasons for it. It is best administered by the bowel, being less liable to cause injurious effects, and more likely to produce good, since it is absorbed as rapidly by the rectum as by the stomach, and in abdominal operations, it tends much to maintain that requisite quiescence of intestinal actions which in all such cases is so desirable. In my own practice I have been accustomed for some years to administer opium by the bowel in preference to the stomach, in all cases of abdominal surgery.

After the operation of ovariotomy, patients may become pregnant. Many of mine have done so, and in one case recorded in the 'Gaz. Méd. de Paris,' 1873, a patient had twins, one male and the other female.

Ovariotomy may even succeed when performed upon a pregnant woman. Mr. Spencer Wells has reported nine such operations with eight recoveries. In five of the nine cases pregnancy preceded and living children were born after natural labor, and in all these, the operation was performed within the fourth month. In the other cases a miscarriage occurred.

On the treatment of suppurating ovarian cysts.—When an ovarian tumor is breaking down and undergoing disorganizing or suppurative changes, whether spontaneously or after tapping, it has been already stated that it is the surgeon's duty to interfere, and to remove what is a serious source of constitutional irritation, and which, if left to itself, must to an almost certainty destroy life. This should be done by means of an exploratory operation. When the tumor can be removed as a whole, so much the better; but, when it has contracted such adhesions with the parts around as to be practically immovable, as much of the tumor should be turned out of the parent cyst as possible, and the cyst itself stitched to the margins of the wound, the suppurating cavity being well washed out once or twice daily, and a drainage tube left in. I have recorded an excellent example of this practice in 'Guy's Hosp. Rep.' for 1868, where a woman, æt. 34, was successfully treated by these means; and more recently, in 1874, I removed a suppurating ovarian cyst associated with acute peritonitis with a successful result.

EXTIRPATION OF THE UTERUS.

This operation, extirpation for fibro-cystic disease and fibrous tumors filling the abdominal cavity, is one that will probably become more frequent as time progresses; but, under any circumstances the operation ought not to be undertaken until the tumor has acquired dimensions as to threaten life, or to render what remains of it miserable. These tumors have often been mistaken for ovarian and operated upon as such, the mistake in diagnosis having only been discovered during the operation. As a rule, they are slow in their growth, solid in their nature, and low down in their pelvic position. They usually also attack women at a later period of life than ovarian tumors. In 1873, I removed a fibrous tumor the size of a large cocoanut from the right cornu of the uterus at the same time that I removed a large ovarian tumor from the left ovary. The lady was æt. 51, and recovered.

The fibro-cystic uterine tumors, however, often present all the external features of the more solid ovarian, and cannot be diagnosed, more particularly when a pelvic examination reveals but little. When the uterus can be made out to form part of the tumor, and to move with it; when the uterine sound can be passed freely into the cavity of the uterus, and be made to extend far beyond its normal distance; when at each monthly period the flow is profuse; when the tumor is fixed well in the pelvis, and the abdominal veins, &c., are turgid from its mechanical pelvic pressure, something more than a suspicion of its fibro-cystic nature may be formed; but when none of these symptoms are present, the diagnosis cannot be made with certainty.

The operation of extirpation of the uterus has been performed with success by Clay of Manchester, Storer of Boston, Koeberle of Strasburg, Keith of Edinburgh, Wells Thornton, Davies Colley, and myself. My own case was in the person of Miss M., æt. 26. The tumor had been growing for three years, and for this she had been under the care of Dr. Oldham, who believed the case to be one of ovarian disease. He sent her to me for operation. On May 19, 1871, I operated, and, finding the uterus and both ovaries diseased, I removed the whole, fixing its base with a large clamp. An uninterrupted recovery took place. Full particulars will be found in the 'Trans. of Obstet. Soc.,' 1873.

I have operated on three other cases but not successfully, one patient dying from hemorrhage caused by the rupture of a pelvic vein, and the others from the shock and peritonitis. In two, I removed the uterus and its tumors by means of the chain écraseur made by Meyer, of Great Portland Street, and I believe this to be the best instrument for the purpose. The chain should be passed well round the base of the growth, and screwed up slowly.

Mr. Spencer Wells prefers a stout pin about the size of a penholder, around which a figure of 8 ligature is passed, the two together acting as a clamp.

This operation is the gravest that the surgeon can undertake, the shock to the system being far greater than in ovariotomy. A good account of the cases done, up to 1866, will be found in the 'American Journ. of Med. Sciences,' for January, 1866.

THE SURGERY OF THE MUSCULAR AND OSSEOUS SYSTEMS.

CHAPTER XXVIII.

AFFECTIONS OF THE MUSCLES AND TENDONS.

Contusions.

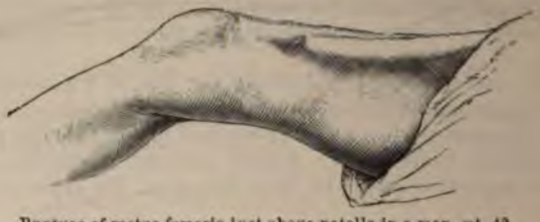
Contusions of muscles, as of other parts, may occur, and when severe may be followed, not only by want of power, but by absolute wasting. Thus, in 1863, I saw a man, æt. 44, who, five months before, received a severe contusion of the left deltoid muscle from a fall upon the shoulder, and, as a consequence, the muscle had completely atrophied, although there was no loss of sensation over the muscle, and in all other respects, the limb was normal.

When wasting takes place, the muscle should be stimulated by galvanism before degeneration has proceeded too far. When due to the want of nerve force, there is little hope of any good result being obtained under any treatment.

Subcutaneous rupture of muscle to a slight degree, is far from being uncommon, particularly of the deltoid, but its complete rupture is very rare. In most cases of strains, some rupture of a muscle takes place, which often shows itself by the effusion of blood into the part.

At times, a muscle is torn across by over-action, as in tetanus, the rectus abdominis being that most frequently affected, but the psoas has been said by Mr. Earle to be so injured. Sédillot reports, that out of twenty-eight cases of ruptured muscle, thirteen occurred at its point of juncture with the tendon. He says also, that rupture occurs only in some involuntary action of the muscle, or, when it is taken unawares. In 1859, I attended a man, æt. 21, who ruptured the left rectus abdominis above the umbilicus, when jumping with some bricks in his hand. He was collapsed after the accident, and when I saw him the next day, the two ends of the muscle were so far asunder as to allow the fingers to be placed between them. In 1863 I also attended a man, æt. 65, who, when lifting a cask with his body bent, felt an acute pain in the posterior part of one thigh, "as if he had been struck with a potato;" he fell forward, and was unable to walk. When I saw him two days after the accident, the semi-membranosus muscle had clearly been divided at its origin from the tuber ischii; the body of the muscle could be felt as a loose, fleshy mass, and below the tuberosity of the ischium, a marked deficiency was present. I have also the notes of a case of complete laceration of the extensor triceps muscle of the thigh above the patella, in a railway inspector, who said that it gave way with a report on his attempting to start off suddenly for a run. In this case there was great effusion of blood into the part within a few hours, which had subsided after the application of ice, the separation of thè muscle from the patella being very distinct. In drawing (Fig. 411), rupture of the rectus femoris is illustrated, and was taken from a male patient, æt. 42.

FIG. 411.



Rupture of rectus femoris just above patella in a man, æt. 42.

Minor degrees of laceration of muscles are of common occurrence, and often followed for many months by pain, stiffness, and want of power in the part, the pain disappearing for a time to reappear on any over-action of the weakened muscle. These pains are often called rheumatic.

Mr. Poland records in his 'Fothergillian Prize Essay' two cases of complete rupture of the rectus abdominis muscle in the hypogastric region, so that the finger could be laid in the dents between the retracted ends. Both occurred in the wards of Guy's Hospital, and in men of advanced years suffering under organic disease, the one had an advanced stage of bladder and kidney mischief the sequelæ of old stricture, the other was suffering from a relapse after continued fever. In both, the accident had been caused by a fall across the iron rods of the bedstead in a vain attempt to rise and walk, and both died a few days after the accident, when complete rupture of the rectus was found in the middle of the hypogastric region. Coagulated blood was present between the divided ends as if only just poured out. No signs of repair existed.

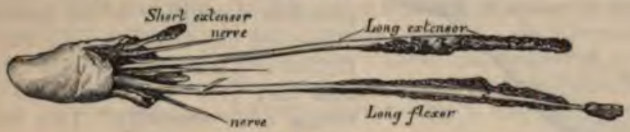
TREATMENT.—In all cases of completely ruptured muscle, the parts must be relaxed in order that the divided ends may be made to approximate as much as possible and be fixed at rest, so that repair may not be interrupted. When much effusion of blood or serum follows, ice may be applied in a bag; and, when absorption has somewhat advanced, a stimulating liniment hastens recovery and gives comfort. When these are not attended to, repair cannot go on; indeed, as a consequence of neglect, suppuration is by no means a rare result, as is seen in psoas abscess. When the laceration has been complete, permanent weakness will remain, and, when the abdominal muscles are at fault, some hernial protrusion of the abdominal contents will take place. In a man who fell from a ship's ladder upon a blunt-pointed iron bar, and had severe rupture of the abdominal muscles attached to the anterior half of the crest of the ilium, a large hernial protrusion existed, and I could press my fist into the opening through the muscles. In such cases some artificial support is permanently needed.

Compound laceration of muscle.—When muscles are lacerated in connection with wounds of the soft parts covering them the injury is grave, and the primary danger of the case as well as the prognosis as to the future use of the part, turns upon the amount of laceration. In compound fractures, &c., this fact is well known.

But, at times, muscles are torn out through skin wounds, or are ruptured at the time of the accident, and may even hang out of the wound. When this is the case, the muscle, unless much crushed or injured, must not be cut away but replaced in position as well as possible, and to further this end, the wound in the soft parts may be enlarged. One of the worst cases of this kind I have ever seen I attended with Dr. Mason of the Barbican. It was that of a gentleman, æt. 22, who, when sleep-walking, fell a height of forty feet out of a window on a glass skylight. Among other injuries he sustained a lacerated wound of his right thigh and complete division of the body of the inner hamstring muscles. When

I saw him, a large mass of well-developed muscle protruded from the skin wound. I enlarged the opening in the integument and carefully replaced the muscle, keeping the limb on a splint. In five weeks he was convalescent. A year later, he had complete movement of his limb. Entire tendons are sometimes torn out of a limb, and in Guy's Hospital Museum there is a preparation (1367), which includes the last joint of the middle finger with its tendon from the flexor profundus attached. It was torn by a threshing machine, the accident being followed by tetanus, yet the patient recovered. In another preparation (1119^{65}) figured below (Fig. 412), there is a portion of thumb with the long flexor and extensor and short extensor tendons, together with the nerves torn out by machinery. It was taken from a man, æt. 17, who made a good recovery.

FIG. 412.



Thumb, with tendons, &c., torn out by machinery.

DISLOCATION OF MUSCLES AND TENDONS.

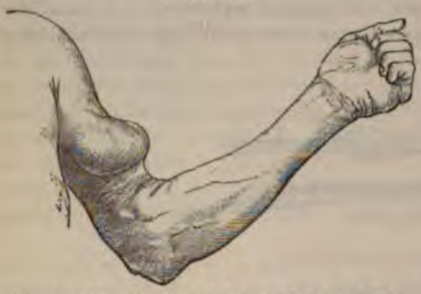
There is good reason to believe that muscles, like tendons, may be dislocated, although from the way the former are protected by fascia and the latter by fibrous sheaths and bony grooves, such accidents are rare. When they occur, they are the result of some sudden and unexpected strain, rick, or twist. In the upper extremity, the accident may occur to the biceps tendon and those about the wrist, and in the lower, to the peronei tendons and tendon of the posterior tibialis as well as to the conjoined tendon of the extensors of the leg attached to the patella and that of the sartorius muscle. It may, also, doubtless affect other tendons.

Whenever it takes place, it can be recognized by the starting of the tendon from its anatomical position, as well as by the pain suffered on putting the muscle into action—the muscle necessarily acting at a disadvantage. The tendon in most cases may be readily reduced, but the greatest difficulty will be experienced in keeping it in position; indeed, it is a question whether the sheath of a tendon when fairly ruptured will ever unite or repair, yet the attempt should be made. In a case of dislocation of the peroneus longus tendon, the only treatment that gave permanent relief was its division, and, what is more, the foot was not visibly weakened by the operation. In 1869, I had under my care, a woman, æt. 29, with a well-marked example of dislocation of the peroneus longus tendon. Some ten days before I saw her, when walking, she felt a sudden pain behind the external malleolus, which led her to think she had been struck with a stone. She was at once disabled and experienced severe pain in the part; and on rubbing her ankle at the time, she felt a cord in front of the bone, which slipped in on moving the foot. Since that time any movement of the ankle caused the same cord to appear. When I saw her, by giving the foot the slightest twist the tendon of the peroneus longus muscle could be readily displaced from its groove behind the external malleolus and made to appear upon the bone, where it could be rolled under the finger. Its reduction was affected by abducting the foot, but it was kept in its position with great difficulty. For this purpose the best means were a good pad of lint fixed over and behind the ankle by means of stripping. I saw her a month after the accident, when she could walk without pain or stiffness; the tendon seemed fixed in its place; but the bandage and pad were applied, and directions given to retain them for a month. I have likewise seen the tendon of the tibialis posticus displaced from behind the inner malleolus.

Dislocations of muscles are probably more rare than those of tendons, and if not, are less recognized. They may be suspected to have taken place where after a rick or strain pain is produced when the muscle is put into action and the pain is fixed to a spot; when it is relieved by relaxing the affected muscles and kneading the part with the hand when so relaxed; and when, moreover, there is no external evidence of a bruise to suggest rupture of muscle. These cases should be treated by manipulation after relaxing the muscles, the surgeon with a strong and firm pressure manipulating the part at the seat of pain; subsequently pressure should be applied, and the muscle kept at rest for a sufficient time to allow the injured part to heal.

RUPTURE OF TENDONS.

Fig. 413.



Ruptured long tendon of biceps. Drawing 37^{80}.

This is more common than rupture of the body of a muscle, tendons usually giving way at their muscular or bony origin. It occurs chiefly in subjects past middle life. The long biceps tendon not rarely gives at its upper end, and, when it does, it imparts to the biceps muscle on contraction, a peculiar appearance; its inner or coracoid half contracting into a hard knot (Fig. 413), while its outer remains lax and but slightly altered. This swelling has been mistaken for tumor of the muscle of the arm. When the one tendon breaks, the other usually follows at a later date, thereby clearly indicating that they give way from some disease which affects their elasticity. In a case I treated in 1858, the two tendons gave way at the interval of four months, and the arm became black and blue after the accident. The tendo Achillis rarely snaps. The plantaris does occasionally, and when it does causes a peculiar dragging of the foot and eversion. In the case of a man, æt. 27, which I saw a few hours after the accident, this symptom was so marked and peculiar as to make it quite pathognomonic. The rupture was caused in taking an upward step of two and a half feet into a vessel with a load on his back. The tendon gave way with a snap when in the act of raising the posterior part of the heel from the ground.

I have likewise the notes of a case of rupture of the tendon of the *biceps femoris* which took place in a boy, æt. 8, who, when hanging on behind a four-wheeled cab, had one of his legs entangled in the wheel. When admitted into Guy's directly after the accident, the tendon of the biceps femoris was made out to have been ruptured at its insertion into the fibula; there was a marked depression at this point, with ecchymosis; the limb was flexed and fixed on an outside splint and a good recovery ensued, although there was some weakness of the muscles supplied by the external popliteal nerve, which had apparently been injured at the same time.

Looking upon the ligamentum patellæ as a tendon, the following example of its rupture may be recorded. In 1867 I was called upon to treat a man, æt. 31, for an injury he had sustained to his right knee ten days previously, while attempting to save himself from falling backwards. The knee swelled after the accident and became acutely painful, and, when I saw him, the patella was drawn up for at least an inch, the ligament having been divided. I treated the case as for fractured patella with a posterior splint, and employed pressure to bring the patella downwards, but I was unable to alter its position to any extent. The man recovered, however, with a useful limb.

Muscles and tendons may be cut like other parts, and then they separate directly. They should be treated like ruptured tendons or muscles by adopting such means as are necessary to bring the divided ends together and to keep them there, splints, bandages, and position being brought into requisition according to the wants of the individual case. The parts should be kept in apposition for at least a month or six weeks. otherwise some stretching of the uniting medium will take place, followed by permanent weakness or deformity.

In certain cases of divided tendons, sutures may be introduced, and several cases are on record in which such treatment was successful.

In wounds where muscles and tendons unite by granulation, some stiffness and want of power in the part will remain for a long time, or even continuously. But in healthy subjects it is remarkable, how tendons at one time fixed, subsequently free themselves from their surrounding attachments and become free again. This hope may always be held out to a patient who takes a gloomy view of his own prospects.

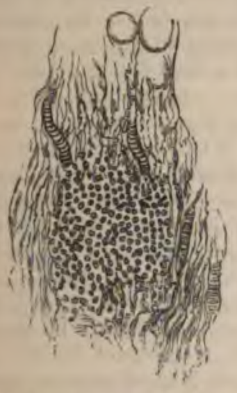
Inflammation of muscle is a recognized affection, and occurs as a consequence of some strain or partial rupture of its fibres, as well as independently of any such cause. It is the more common as a result of injury, and is seen not seldom in the rectus abdominis as well as in the psoas muscle; indeed, as a cause of psoas abscess, I believe it to be more common than spinal disease. As a result of septicæmia, it is frequently met with; and is found in every muscle, even the heart. It appears as a more or less acute affection of the muscle, and is accompanied by swelling, local pain and constitutional disturbance;

suppuration occurs in due time. The symptoms rarely come on directly after the injury, but probably after the lapse of several weeks as a consequence of some want of repair in the injured part, and from the non-observance of the necessary rest which an injured muscle so much requires in the process of healing. When an abscess forms in a muscle the sooner it is opened the better, recovery readily following, even when the disease is in such a muscular organ as the tongue.

Inflammation of muscle as an independent affection is generally chronic, and in adults is chiefly of syphilitic origin. In infants it is met with most commonly as an affection of the sterno-mastoid muscle; the body of the muscle wholly or in part appearing as an indurated mass. It is generally observed soon after birth, and may at times be traced to some injury sustained at that time. I have seen it in the offspring of syphilitic parents, but more frequently when no such history could be obtained. In fifteen consecutive cases, a syphilitic history was obtained only in one. These cases rarely if ever suppurate in infants, but, under the use of warm fomentations and some simple tonic, such as cod-liver oil, proceed to a natural recovery. I have never seen a case fail to recover by these means.

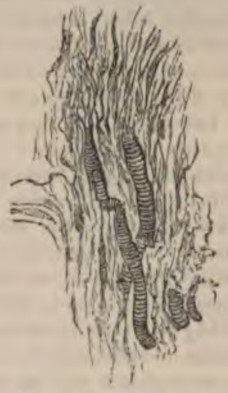
In the *early* period of the disease, the inflammatory product is cellular; in the *later* fibrous. These points are seen in the drawings 414 and 414*a*, which have been kindly made for me by Dr. Goodhart. They were taken from a patient of Dr. F. Taylor's, æt. 5 weeks, who looked healthy, but had had "snuffles," slight fissuring of the anus, and superficial ulceration of the scrotum. There was no history or other evidence of syphilis in the parents. The child died from atelectasis. The tumor in the *left* muscle was only noticed in the fifth week after birth, and the *right* muscle was never noticed to be diseased. The case is reported in the 'Path. Soc. Trans.,' 1875, vol. xxvi.

FIG. 414.



Showing the early or cellular stage from the right muscle.

FIG. 414*a*.



The late or fibrous stage from the left muscle.

The student should remember that this affection appears as a simple induration of the muscle, and is, therefore, unlike any glandular or other affection.

Chronic inflammation of the sterno-mastoid is likewise met with in adults, and, I believe chiefly as a consequence of syphilitic disease. It attacks the muscles in the same way as it does others, such as those of the tongue, the extensor triceps of the thigh and of the arm, the temporal, masseter, or other muscles, the muscle or muscles becoming infiltrated more or less diffusely with the well-known syphilitic inflammatory products. These tumors, when their nature is recognized and right treatment employed, can be re-absorbed; but if neglected and left alone, after attaining their full size, which is rarely great, break up and suppurate, giving rise to deep-seated abscesses, which, when they have discharged externally, leave deep, irregular, excavated sores. In the tongue these simulate closely cancerous sores; many of the cases of supposed cured cancer of the tongue being, doubtless, of this origin. In other parts, they have much the aspect of the deep cellular membranous ulcers which have been already described. As a part of syphilis, they always appear late in its course, and remote from the primary inoculation. When it appears in the adult, in the sterno-mastoid muscle, it more frequently attacks its sternal end than its body.

After the disease has ceased, atrophy of the affected muscle is a common consequence. Contraction occasionally follows, though I have never seen it. MM. Ricord and Notta have, however, recorded examples.

Recognizing the syphilitic nature of this affection, the treatment should be conducted on the usual principles; large doses of the iodide of potassium, say fifteen to thirty grains, may be given three times a day with advantage; not in such full doses at first, but by gradual increase from one to five grains. Mercury may also be given, the mercurial suppository once or twice a day being the best form. In the chapter on syphilis this practice will be found described in detail.

Atrophy of Muscle.

The surgeon can see this under a great variety of circumstances. He is the most familiar with it as a consequence of want of use in disease of the joints, or any other affection in which the limb is kept at rest; and under these circumstances the muscles simply waste; they undergo no other change in structure, and are capable of complete restoration on reassuming their normal action.

In a large number of cases of infantile paralysis, the same thing may also be said, for under the stimulus of galvanism or the continuous current, persevered in for many months, the thinnest limbs plump up, and the feeblest muscles become capable of performing the work for which they were intended. Indeed, in these cases where deformity does not complicate the case a good result may be looked for.

After fevers, however, lead poisoning, rheumatism, scrivener's palsy, and alcoholism, the muscles may undergo genuine degeneration, either granular, fatty, or waxy, and according to Lockhart Clarke "there is another form of this malady, which is known by the name of *progressive muscular atrophy* (Cruveilhier), *atrophie musculaire graisseuse progressive* (Duchenne), and *wasting palsy*. This curious disease differs in several respects from the other atrophies. It is always chronic, but of uncertain duration, is frequently hereditary, capricious or irregular in its invasion, prone to spread from one part to another, or become general, and thus go on to a fatal termination. The affected muscles suffer different degrees of wasting, and assume a variety of aspects. Even in the same muscle bundles in different stages of atrophy and degeneration may be found at the side of others that have retained their normal state. When the wasting is extreme in all the bundles, a long muscle may be reduced to a mere fibrous and cylindrical cord, or to a kind of tendon, and a flat muscle may be reduced in the same manner to a kind of membrane. In some instances the atrophy may be *simple*, that is, the muscular tissue may be wasted to a considerable degree without any granular or fatty degeneration; but generally one or both of these alterations of structure is found to exist to a greater or less extent. The muscle also changes and varies in color, according to the nature and degree of the atrophy. It is paler than natural; occasionally it is quite colorless, like the flesh of fish, or it may have a faint yellow or ochreous tint. Its consistence for the most part is increased in consequence of the increase in the interfibrillar connective tissue. When examined under the microscope the affected muscles may be seen to have lost, to a variable extent and degree, or even entirely, the appearance of transverse and longitudinal striation, while in a corresponding proportion the sarcous or muscular element is transformed into granules, which in some instances are too fine to be distinguished as separate particles. The granules are soluble in acetic acid. In this odd affection the granular, fatty, and waxy degenerations are found side by side" ('Holmes's Syst.,' 2d ed., vol. iii).

This disease is said to appear more commonly in the hand and right upper extremity, progressing upwards to the trunk, and then over it to the lower extremities. It rarely commences in the lower limbs. It begins with loss of power in the part, but rarely with any loss of sensation, this symptom gradually increasing. Want of muscular co-ordination soon appears, as well as awkwardness in the patient's movements, cramps, twitches, and fibrillary tremors take place, occasionally with pain or some cutaneous anæsthesia. Cruveilhier believed that atrophy of the motor nerves was the starting-point of this disease; but this theory is not now entertained; Lockhart Clarke says, "In 1861 I discovered, in the spinal cord removed from a well-marked case of this disease, numerous lesions of the gray substance, consisting chiefly of areas of what I call granular and fluid disintegration; and I have seen the same in other cases since." This view is taught by Trousseau, Duchenne, Meryon, Roberts, Cohn, and others.

This disease is generally hereditary, more common in males than females, and is excited by excessive muscular exertion, cold, and damp, as well as by injuries or disease of the spine, syphilitic or otherwise.

TREATMENT.—Removal of the cause is the primary object, and when syphilis is suspected, special treatment should be employed. Tonics are always of use, and arsenic in Dr. Meryon's hands has met with good success; "but of all remedies hitherto employed, galvanism is undoubtedly the most useful when applied to the affected muscles;" while Clarke states, that setons and blisters to the spine may be employed in the early stage.

Degeneration of muscles with apparent hypertrophy, called Duchenne's disease, after its first describer in 1858, is a strange affection which attacks children, but continues to affect them for many years of their youth. I have placed it amongst the affections of the muscles, but the observations of Dr. L. Clarke ('Med.-Chir. Trans.,' vol. lvii, 1874) clearly places it amongst the neuroses. It begins with weakness of the lower limbs which is lasting, and passes on to a progressive enlargement of the gastrocnemii, then of the glutei and lumbar muscles, and occasionally of all the muscles. These feel firm and elastic, and hard on contraction. After a variable period, at times years, the paralysis gradually increases and becomes more general. "The patient is no longer able to stand upright, the upper extremities become affected, the enlarged muscles rapidly decrease in volume, and the limbs and trunk become atrophied *en masse*. In this state the patient may exist for a considerable time, but ultimately dies from intercurrent disease. Many of the children affected with this singular disorder have dull intellects, and are more or less idiotic." (Clarke.) Pathologically, great hypertrophy of the connective tissue of the muscles is to be found, the fibres themselves show finer striæ and are transparent, large collections of fat-cells also exist. Neither medically nor surgically, does any treatment seem to be of benefit.

Muscles at times ossify either in parts or in groups. In the College of Surgeons there is a specimen in which nearly all the muscles of the back had become ossified, and at St. George's Hospital, a similar preparation exists; the case being recorded by Cæsar Hawkins ('Med. Gaz.,' 1844). The disease is supposed to be inflammatory in its origin. Some years ago, one of my colleagues at Guy's excised a piece of bone from the body of the deltoid muscle, an inch long, the growth of seven years.

TUMORS IN MUSCLE.

These are of rare occurrence, and always of a serious nature. They are mostly of the fibrous or fibro-cartilaginous kind. In 1866, I excised one of two years' growth from the fleshy portion of the external oblique muscle of a woman æt. 31 ('Path. Soc. Trans.,' vol. xviii). The tumor separated the fibres of the muscle which it infiltrated, and, microscopically, it had all the elements of the fibro-plastic tumors. It returned within the year, and when I last saw the patient, in 1869, there was a second growth the size of a cocoa-nut occupying the place of the original tumor. In 1868, with Dr. Burchell, of Kingsland, I removed from the abdominal muscles of a woman, æt. 33, a myxomatous tumor, eight or nine inches in diameter, of two years' growth.

Cancerous tumors may originate in, but more frequently infiltrate, muscles as secondary growths or by extension from other parts. Surgeons see them in the pectoral muscles in acute or neglected cases of cancer of the breast; in the periosteal cancer of bone, as well as in other parts. In the tongue and lip they may be regarded as new growths.

Hydatids, likewise, are found in muscles as in every other tissue, as painless, tense, globular, swellings. So also is that curious nematode worm the *Trichina spiralis*, which, in man, seems to be taken into the body through eating the insufficiently cooked flesh of animals infested with them, particularly that of pigs.

"Trichinæ, as ordinarily observed in the human muscle, present the form of spirally coiled worms in the interior of small, globular, or lemon-shaped cysts, which latter appear as minute specks scarcely visible to the naked eye. The specks sometimes resemble little particles of lime, and are more or less calcareous externally, according to the degree of degeneration which their walls have undergone; these cysts are not, however, essential."
—*Cobbold.*

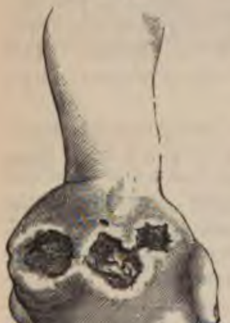
When these worms are present in large numbers in the body they give rise to a disease known as trichiniasis which is most fatal. Drs. Boehler and Königsdöffer, of Central Saxony, who first saw this disease according to Leuchart who described it, state that "the affection began with a sense of prostration, attended with extreme painfulness of the limbs; and after these symptoms had lasted several days, an enormous swelling of the face very suddenly supervened. The pain occasioned by this swelling and the fever troubled the patients night and day. In serious cases the patients could not voluntarily extend their limbs, nor at any time could they do so without pain; they lay mostly with their arms and legs half bent—heavily, as it were, and almost motionless, like logs. Afterwards, in the more serious cases, during the second and third week an extremely painful and general swelling of the body took place," a large proportion of the cases died. Dr. Thudicum has given an able report on this subject in the 'Medical Officer's Report' to the Privy Council, 1864.

Vascular tumors of muscle have been made the subject of a special paper by Mr. C. de Morgan ('Brit. and For. Med.-Chir. Rev.,' 1864), and Mr. Teevan has published an able paper on tumors in muscle in the same Review for 1874. These, however, are very rare. The vascular tumors of erectile tissue attack a muscle either as a diffused or encapsuled growth, or as tumors having the appearance of varicose veins around the muscle. They are chiefly though not always congenital, and are generally found in the lower extremities. They have no definite clinical history beyond their gradual and painless increase. My colleague, Mr. Howse, in 1872, excised such a non-encapsuled growth from the biceps muscle of the thigh of a woman, æt. 23, which was made up of erectile tissue and highly vascular, and had been growing for eight years. He excised all the muscle that was involved, but left its tendon. A good recovery ensued, with free movement of the limb.

TUMORS OF TENDON.

Besides ganglion, other tumors are found connected with tendon, and of these, the cartilaginous and fibrous are the most common. Some are said to begin as ganglion and subsequently to consolidate. I have seen one composed of bone and cartilage of two years' growth removed from the extensor tendon of the hand which was said to have such an origin. Tumors with tendons passing through them are not rare, and on two occasions I have had to amputate the hand of a child for a cancerous tumor occupying its palm, through which all the flexor tendons passed (Fig. 415). In 1867 I removed from a boy, æt. 3½, a congenital tumor the size of a walnut, which evidently grew from the theca of the tendon of the long extensor muscle of the thumb. The tendon passed through the tumor which surrounded it. Dr. Moxon examined the growth with myself, which was clearly composed of fat or condensed fibro-cellular tissue.

FIG. 415.



Cancerous tumor of the hand. Dorsal aspect.

The majority of tumors connected with tendons, however, are of the nature of ganglion more or less indurated.

What has been described as *the rider's bone* is probably at first an inflammatory infiltration and subsequently an ossification of the tendon of the pelvic origin of the adductor longus or magnus muscle. I had such a case under observation in the person of a medical friend, æt. 44, who while hunting in 1869, made a violent effort to grip his horse when about to make a long jump. The effort was not attended with any pain, but was followed by much ecchymosis extending down to the knee, and loss of power in the muscles of the part. When these symptoms had subsided, a dense induration was felt in the pubic origin of the right adductor longus muscle, which was painful on manipulation. As time passed, this induration not only lasted but became more dense, and when I first saw him about three months after the accident, it was clearly in the sheath of the adductor longus and moved with it. It grew somewhat during two years, and, when the tendon was rigid, it appeared as an outgrowth from the pubis corresponding to the origin of the adductor longus, of about two inches in length. When the muscle relaxed, it was clearly only in the tendon, and had no bony origin. At the present time, this gentleman can take his exercise as usual. There is a distinct grating to be heard and felt on moving the tumor, which has not grown for the last three years. The history of the case is identical with that given by Birkett ('Guy's Hosp. Rep.,' 1868). Billroth has also described this affection.

Virchow is said by Holmes to have recorded the fact, that a similar ossification of the muscles of the left arm of the Prussian soldier takes place, and is termed "exercise bone."

INFLAMMATION OF TENDONS.

As an acute affection, this is most serious and gives rise to severe local and constitutional symptoms. It is met with as a consequence of a severe strain or laceration of tendon, or of some punctured or other wound involving the sheath. It may begin in one toe or finger and spread upwards to the palm, and so on to other tendons and even up the forearm. The local symptoms are pain with the external evidences of inflammation, heat, redness, and swelling; the swelling being deep-seated while the pain soon extends up the arm beyond the seat of mischief. The constitutional symptoms are those of more or less severe pyrexia.

If surgical interference is not brought to bear upon the case at an early period, suppuration must soon appear with the local symptoms of throbbing and aggravated local distress, and the constitutional symptoms of rigors, excitement, and depression; inflammation of the absorbents and their glands will probably complicate the case.

Under still more neglect, sloughing of the affected tendons, and diffused inflammation with suppuration of all the parts involved in the disease will ensue. A finger, hand, or forearm, may be jeopardized or sacrificed, if the inflammation be very active or the treatment with which it is met insufficient.

Absorbent inflammation and blood poisoning (septicæmia) are common accompaniments of this affection.

TREATMENT.—This affection is very amenable to surgical control, and a free incision into the swollen part is the best means of arresting its progress by relieving tension. The operation not only relieves pain, which is caused by the tension of the fibrous tissues from the effusion beneath, but arrests the progress of the affection, by preventing the inflammatory effusion burrowing up the theca of the tendon.

For these objects a clean cut down to the theca should be made as soon as hardness of the parts, with external evidence of inflammation, appears. If pus escape the practice must be good, but if serum only, the operation will tend to arrest the progress of the affection at its onset, prevent the formation of pus, and probably check the disease. The incision should be *vertical* over the middle line of the finger and the centre of the tendon; no vessel or nerve of importance being there in the way.

When suppuration exists, the surgeon must follow up with his lancet every line of inflammation and suppuration, for in no tissue does more harm ensue from retained fluids than in the fibrous.

In the very earliest stage of the inflammation warm fomentations and possibly leeching may be beneficial. Elevation of the limb undoubtedly relieves pain, the hand being higher than the elbow, and the elbow than the shoulder. A saline purgative is often serviceable. But the surgeon must not lose time by such temporizing means; for tension of the part means its death by strangulation, if not mechanically relieved, and medicines have no material influence upon the affection. When suppuration appears, tonics and liberal diet are required, as well as stimulants carefully adjusted to the necessities of the case. Sedatives are always wanted in some one of their forms. Morphia acts the most rapidly in quarter- or half-grain doses given subcutaneously. Water dressings or poultices should be applied. In very severe cases when the powers of life are failing, amputation may be justifiable, more particularly when the prospects are small of giving a useful hand or arm. For the arrest of diffused inflammation in the hand and arm the occlusion of the main artery of the limb has been suggested. Moore and Maunder have both adopted it in the upper extremity, with enough success to justify the practice. Bleeding is apt to take place at times during the progress of the sloughing of the tendon, and if recurrent, such a complication is likely to induce the surgeon to perform some operative act for its control upon the main vessel of the extremity. Before doing this, however, he should always remove any sloughing tendon, as I have known hemorrhage even of a severe kind to be kept up by the presence of a sloughing tendon in a part, and to have been arrested by its removal.

CHRONIC INFLAMMATION OF TENDONS.

The thecæ of the tendons of the extensors of the thumb, of the tendo Achillis, and the long tendon of the biceps, as of other muscles, are liable to inflame, and this action is attended by pain and weakness on moving the muscles, and at times by swelling. More frequently, however, the affection will show itself by a peculiar crackling sensation which may be felt on grasping the part when the muscles are in motion. This crepitation when it has followed an injury, has more than once been mistaken for that of fracture; yet it is distinct, and when once felt ought to be recognized. The affection is readily cured by rest of the affected muscles, through the application of splints and by counter-irritation by means of one or more blisters. The inflammation rarely goes on to suppuration unless neglected.

AFFECTIONS OF BURSÆ MUCOSÆ, SYNOVIAL CYSTS, GANGLION, ETC.

Simple bursæ are protective synovial sacs found in the subcutaneous tissue, wherever pressure or friction is persistently present.

Synovial bursæ are of the same kind and are formed in the same way, although situated between bone and muscle, tendon and bone, or between muscles; while some synovial bursæ are really *synovial herniæ*, or pouchings of an over-distended membrane of a joint into the connective tissue between the muscles. *A ganglion* is a bursa swelling directly connected with the sheath of a tendon, and may be *local* or *diffused.*

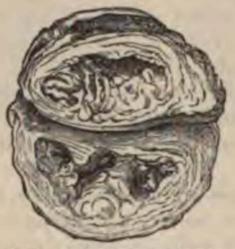
When a bursa (simple or synovial) has an established anatomical position it is called normal, and when it is a purely pathological production, accidental. Any of these bursæ are liable to inflame, suppurate, or consolidate.

Simple bursæ.—The subcutaneous bursa over the patella or its ligament is more commonly enlarged than any other, and when it is so is known as the "housemaid's knee." When it acutely inflames, suppuration rapidly takes place, and if an external outlet for the pus is not soon established diffused suppuration around the knee and over the patella follows. Indeed, most of the cases of diffused suppuration around the knee have their origin in "bursitis."

When the inflammation is less acute and shows itself by serous effusion into the bursa, it may give rise to local pain on pressure and a peculiar crepitation, this crepitation often existing before any perceptible enlargement of the bursa has taken place.

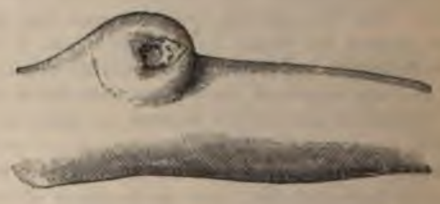
In the more advanced stage, when the effusion has increased, an encysted fluctuating swelling will have formed, which may be tense or flaccid, the degree of tension of the bursa turning entirely upon the rapidity of the effusion. In more chronic examples, the bursa will appear harder, firmer, and less distinctly fluctuating, while in very neglected or chronic cases, it may have so consolidated as to appear as a solid tumor, although the tumor will contain on section some cavity in its centre, the mass appearing to be made up of concentric laminæ of organized lymph (Fig. 416). In exceptional cases, however, the bursa may have completely consolidated. These bursæ, as a rule, contain simple serum, although at times serum is blood-stained, while in other cases, rice-like bodies (organized fibrin) or pedunculated fringe-like outgrowths like loose cartilages exist. When injured these bursæ may become filled with blood—their contents being grumous or like coffee-grounds (hæmatocele). Bands of lymph cross the sac at times, but more frequently they line it in regular, onion-like layers. In neglected cases, this fibrin may die and slough away, the bursa being cast out as a whole as in an ordinary cellular membranous ulcer, and in the case from which Fig. 417 was taken. In syphilitic subjects, this result is not unfrequent.

FIG. 416.



Semi-solid bursa, laid open. (Guy's Museum.)

FIG. 417.



Bursa sloughing from over patella.

On the other hand, a bursa may increase by effusion, and by some external cause rupture subcutaneously or externally, and thereby undergo a cure. In 1870, I had a case of the former kind under my care in a man æt. 60, who had a bursa the size of a fist over his patella, which ruptured on kneeling. When I saw him, the cellular tissue about the knee was infiltrated with serum which was subsequently absorbed, and the bursa did not reappear.

What has been described as taking place in the bursa over the patella may occur in other parts, and more particularly over the olecranon process, where an enlargement of the bursa goes by the name of the "miner's elbow." I have, however, seen them over the acromion process in men who carry timber; over the tendon of the extensor triceps muscle of the thigh in a woman who habitually started her sewing machine with the knee; over the tuberosity of the ischium in Spitalfield's weavers ("weaver's bottom"), and in Thames lightermen; over the dorsum of the foot in extreme cases of talipes equinovarus when the children walked upon the part; over the external malleolus in tailors; over the malleoli and also the instep from the pressure of a boot; over the great trochanter of the femur in a soldier from pressure caused by sleeping on a board; and last, but not least, over the ball of the great toe in cases of "bunion," and in the sole of the foot over the heads of the metatarsal bones in men who walk much with short shoes, or with some who have contraction of the extensor tendons of the toes.

Bursæ will, however, enlarge or form wherever there is pressure, the enlargement being in a measure compensatory to save deep tissues. Yet this rule does not hold good always, for I have seen more than one instance in which enlarged bursæ existed over the knuckles of the first phalangeal joint of the hands without any such cause.

TTEATMENT.—In the early crepitating stage of effusion, the removal of all pressure and the application of a blister are, probably, sufficient to effect a cure, and, in more advanced stages, the repeated application of blisters is often sufficient to excite absorption of the effused fluid and recovery. When these means fail and the walls of the bursa are thin, the cavity may be tapped and the parietes of the cyst firmly pressed together by means of a pad and strapping. When the walls are indurated, this treatment is useless; but a cure may generally be effected by the introduction of a seton which should be kept in till suppuration is freely established. In more solid cysts, none of these means are of use, and excision is the only sound practice, the surgeon making his incision over the outer border of the bursa in order that the cicatrix may be out of harm's way. In some few instances where tapping has proved ineffectual, the cyst may be injected with twenty drops of the compound tincture of iodine in a drachm of water as in hydrocele. When blood has been effused into the bursa from a blow, as indicated by its sudden increase, a free incision into the cyst and the evacuation of the clots may be expected to be followed by a recovery; but this should only be done when its absorption does not take place by natural processes. When loose or pedunculated bodies exist in a bursa and cause distress, they may be removed by means of a free incision through its walls.

SYNOVIAL BURSÆ.

An enlargement of a synovial bursa is a far more serious affection than that which has been just described: as these bursæ are situated about tendons or muscles, the articular extremities of bones and joints, and in many instances, indeed, have direct communication with joints.

There is a deep bursa beneath the deltoid muscle which, when inflamed, gives rise to swelling around the shoulder-joint, and pain and crepitation on movement, simulating shoulder-joint mischief; at times, too, this bursa communicates with the joint through the bicipital groove in which the biceps tendon plays. It may be distended with serous fluid or may contain loose bodies such as are found in other bursæ or ganglia. They should be dealt with cautiously on account of the possibility of their communicating with the joint. Hence, blistering and absolute rest of the arm are the best means to employ, the bursæ being opened only when obstinate, and when pouching exists in front of the deltoid tendon. From one of these bursæ on two occasions, I have evacuated within three months, more than half a pint of bursal fluid, containing melon seed-like bodies, a recovery subsequently taking place. Such an operation should, however, be done only after grave consideration.

Another extensive bursa, situated beneath the *extensor muscles of the thigh*, is not unfrequently the seat of acute or subacute inflammation, and such cases have been mistaken for inflammation of the knee-joint. The diagnosis ought not, however, to be difficult, for in the bursal enlargement however great, the bulging of the cavity will seldom extend downwards beyond the upper border of the patella; and will not, as in joint disease, extend to either side of that bone or below it. Fluctuation, moreover, will only be felt above the joint and not obliquely through it. When the patient stands, the difference between the distension of the bursal and that of the synovial sac will be also at once manifested. With this enlargement, there may be some stiffness of the joint, but there will be always mobility. This bursa at times becomes the seat of suppuration, when the necessity of a correct diagnosis is more important on account of treatment. In all cases it is necessary to maintain rest, and the absorption of the fluid should be promoted by blisters. In obstinate cases when the bursa is very tense, the cavity may be tapped, and, when it suppurates, freely opened, but neither of these operations should be undertaken without a strong necessity, for suppurative inflammation of the bursa may extend to the joint with a fatal result. I have, however, tapped such a bursa in a woman, æt. 35, and drawn off eight ounces of a thick, grumous-looking, semi-purulent fluid with success; in a second case, a woman, æt. 50, I made a free incision into the bursa, and evacuated many ounces of pus and blood, such as escapes from a hæmatocele; a good recovery took place.

The deep bursa between the ligamentum patella and the bone is very liable to inflame and enlarge, which gives rise to pain that is often mistaken for joint disease. The pain, however, is always local over the bursa and aggravated by the patient attempting to raise the extended leg. It is very troublesome, and when established, can only be treated successfully by means of blisters and rest with the leg on a splint.

The bursa situated over the upper part of the tuberosity of the os calcis, between the bone and the tendo Achillis, is sometimes inflamed, and gives rise to a marked projection in the part; it causes pain and lameness. It is to be cured by absolute rest (the foot and leg being fixed on a splint) and the application of blisters.

A bursa also naturally exists in connection with and beneath the tendon of the psoas muscle as it passes over the arch of the pelvis; this also may communicate with the hip-joint. When distended with fluid it will give rise to a swelling in the upper part of the thigh on the inner side of the femoral vessels, which will be soft and fluctuating, but not receive any impulse on coughing, like a psoas abscess, for which it is apt to be mistaken.

The bursa between the tendon of the gluteus maximus and trochanter may also inflame and suppurate, and, when it does, it gives rise to a troublesome and often dangerous affection. When suppuration takes place, an opening may be made, which should be free, but the thigh must be well fixed. When suppuration does not occur naturally the surgeon should be in no hurry to open the bursa, but be satisfied to keep the limb at rest and blister the swelling.

Synovial bursæ in the popliteal space requires a rather longer notice than the forms to which attention has already been directed, since they are, although common, sometimes difficult to diagnose and dangerous to treat. Their treatment, however, as a rule, is successful.

These bursæ may be divided in a clinical point of view into two classes—the *first*, including such as are connected with the sheaths of tendons or that encircle their insertion, and have no communication with the knee-joint; the *second*, those that directly or indirectly communicate with the joint and are either synovial herniæ pouching from it, or bursæ originating about the tendons and communicating with it.

Among the *first* is the normal bursa which exists above the head of the fibula on the outer border of the popliteal space between the insertion of the biceps muscle and the external lateral ligament; a *second*, which may be said to be on the outer border, although it has a somewhat more central position which separates the external lateral ligament from the tendon of the popliteus muscle; and a *third* on the *inner* side of the space which lies between the tendon of the semi-membranosus muscle and the inner tuberosity of the tibia—the whole of these bursæ occupying the *lower* half of the popliteal space.

In the *second* division, there is the smaller bursa which separates the outer head of the gastrocnemius muscle from the outer condyle of the femur, and the larger that normally exists between the internal condyle of the femur and the inner head of the gastrocnemius and semi-membranosus muscles, and which generally sends a process between these muscles, the smaller occasionally and the larger generally communicating with the knee-joint, both of these occupying the *upper* half of the popliteal space.

The larger bursa may have its origin on the inner side of the popliteal space, but as it grows, invariably encroaches on it and becomes central, and is far more frequently enlarged than any of the other popliteal bursæ.

All these normal synovial bursæ may become enlarged under the influence of over or prolonged exertion or any sudden strain, the smaller ones increasing to the size of a walnut, and the larger to that of an orange. As they increase so they become central, and as they assume a central position difficulties in their diagnosis may be experienced. They may contain a thin, clear, or blood-stained serous fluid; a tenacious, synovial, or colloidal, apple-jelly-like material, and, in exceptional instances may have consolidated. I have, however, known this to occur but once. It is probable that the bursæ which have serous contents do not communicate with a joint, while those that have synovia do.

Diagnosis.—In a general way there ought not to be any difficulty in making these cases out, more particularly when the different positions in which they may appear are known, since their circumscribed and defined outline, their fluctuating feel and mobility when the leg is flexed, and their hardness and elasticity when fully stretched fairly characterize them. When, however, the swelling pulsates and a bruit is heard over the tumor, some difficulty in diagnosis may be felt, although I can hardly understand how such a case could be mistaken for an aneurism, as on a careful examination the bursal pulsatile swelling could not be emptied and refilled by pressure upon the afferent artery, as would an aneurism; neither would the pulsation be so distinct nor the bruit so clear; for both the pulsation and the limb would have been simply communicated. The position of the bruit, moreover, would have a greater influence upon the symptoms in a case of bursa than in that of aneurism; for whereas in the latter, by *slightly* flexing the leg upon the thigh, the aneurism would become more defined, its pulsations more marked and under control, in bursæ the swelling would become more flaccid and less distinct. Extension makes the pulsation and the swelling to be more distinct in the case of bursæ, and less so in that of aneurism.

With respect to the diagnosis of a synovial bursa which communicates with the knee and a true synovial hernia, I have not much to add beyond the fact, that in the former there may be no symptoms of knee-joint disease, whereas in the latter, there will to a certainty be chronic effusion into the joint, which probably will be part of an osteoarthritic change.

When pressure upon the popliteal swelling causes it to diminish or disappear, while the joint itself enlarges and becomes fluctuant, or more so under the pressure, it is a fair inference that the joint and bursa communicate, although when these conditions do not exist, it would be wrong to infer the opposite, for the opening from a bursa is at times valvular and altered by position.

TREATMENT.—As an enlargement of these bursæ always follows excessive muscular action and strains, so by absolute rest of the limb as guaranteed by a splint and the application of repeated blisters, can the bulk of them be made to disappear. In obstinate examples of the first division of cases tapping may be resorted to, whereas in the second it should be undertaken only where other treatment has failed, and then with extreme care by means of the aspirator. In still more obstinate cases where the limb is rendered useless, a free incision may be made into the cysts, or they may be excised; but such desperate measures are only applicable in desperate cases.

The first division of cases may always be boldly dealt with, but the second should be treated with extreme caution.

Thus, in a case which was under my care some years ago, where by repeated blistering the tumor disappeared for a time only to recur, a surgeon was induced to tap and subsequently incise the cyst, after which, acute suppuration of the part occurred, which in the end compelled amputation.

The case of solid bursa already alluded to occurred in my own practice. I mistook it for a tumor, having punctured it with a needle without obtaining any flow of fluid. It was in a man of middle age, had been growing for about ten years, was the size of a fist, filled the popliteal space, and was solid and movable. I found that it was connected with the inner hamstring tendon only on making the attempt to remove it. On recognizing its nature, I took away a large portion of the mass down to its central cavity, which was the size of a nut, but I left the deeper part. Suppuration, however, subsequently attacked the knee-joint, and amputation became necessary. I am unable to point out how a correct diagnosis could be made in such a case as this, but the record of the fact that a solid bursa may exist in this locality, as well as the unfortunate result which accrued upon operation in my case may be of value. Holmes draws attention to a valuable paper by M. Foucher on this subject in the 'Archives Générales de Méd.' 1856.

SYNOVIAL CYSTS.

In connection with this subject of synovial hernia it should be stated, that at times these herniæ rupture and the synovial fluid escapes into the connective tissue of the leg, forming a synovial cyst; and, if Mr. Wormald was right when he taught that the thinnest point of the joint capsule was at the spot at which it partially encircles the tendon of the popliteus muscle, it is more than probable that it is at this spot that the fluid escapes.

The synovial cyst may occupy the popliteal space and upper part of the calf of the leg, or may be evident in the calf of the leg only, projecting most, as a rule, on the inner aspect of the leg, or may be perceptible only at the upper and inner part of the leg as a small defined swelling not approaching within three or four inches of any part of the knee-joint. There need not of necessity be any communicable fluctuation between the cyst and the joint.

These cysts are generally found in joints that are the seats of osteoarthritis and are curable. They should not be punctured or otherwise subjected to operation unless there appear strong reasons for so doing, inasmuch as interference may lead to acute inflammation and suppuration of the knee-joint.

For this information I have to thank Mr. Morrant Baker, who has written a valuable paper on the subject in the 'St. Bartholomew's Hosp. Rep.,' 1877. It recalled to my recollection several cases which were doubtless of this affection, and which I did not understand.

GANGLION.

This is met with in two forms, the one the more common as an encysted swelling connected with the sheath of a tendon; the second as a more diffused swelling involving the theca of one of many tendons, those of the wrist being the most commonly affected; and the flexors more frequently than the extensors. I have, however, seen it in the extensors of the toes, and on the dorsal aspect of the foot beneath the annular ligament of the ankle; but it may attack any tendon. Ganglion is always the result of strain or over-action of the tendons. The local ganglion always contains colloidal apple-jelly-like material, which is at times crystal-like in clearness, at others pinkish. In the diffused, the fluid is more like synovia, containing loose bodies.

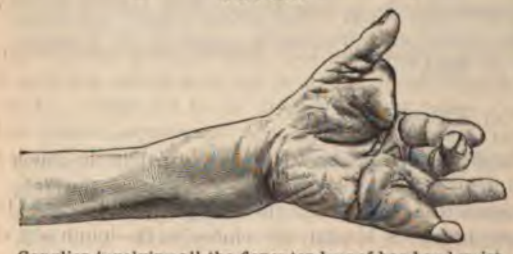
"The bursæ or ganglions which form about the sheaths of the tendons at the wrist appear to be the cystic transformations of the cells inclosed in the fringe-like processes of the synovial membrane of the sheaths. . . . Sometimes they are distended with serous fluid; at other times their contents possess a gelatinous or even a honey-like consistency, which constitute a form of meliceris. Under some circumstances free fibro-cartilaginous-like bodies, irregularly shaped, composed of a compact connective substance, form in considerable numbers, more especially in the ganglionic enlargement of the synovial bursa which surrounds the flexor tendons of the fingers at the wrist."—*Paget*, 'Surg. Path.'

The localized form of ganglion is more common on the dorsal aspect of the wrist than anywhere else, although not rarely it is connected with the flexor tendons; and appears as a globular or irregularly cystic, tense swelling of the part. At times, it is very hard, at others, fluctuating and soft. When of good size, it may be translucent. Pressure upon it to any extent causes pain, severe pressure sickening pain, even fainting and vomiting. Those in the palm of the hand about the head of the metacarpal bones are the most painful. At times, ganglion is painless, causing only some weakness of the wrist.

A large ganglion occasionally forms behind the external malleolus connected with the peronei tendons. It should be touched with care.

The diffused or compound ganglion varies in its symptoms according to the number of tendons involved. When one only is affected it may appear as a deep-seated, fluctuating, irregular swelling in the course of the tendon, the amount of swelling and deformity depending entirely upon its size. The swelling, when many tendons are involved, will be diffused; but when the whole of the flexor tendons are implicated it will occupy both the palm of the hand and the forearm above the wrist. In the case illustrated in Fig. 418, taken from a woman, æt. 49, sent to me by Dr. Lovegrove, now of Hythe, all the flexor tendons were involved to an extreme degree. In such cases as these, the foreign bodies, commonly called "melon-seed or rice-like" bodies, are usually present. They may frequently be made out to exist by the surgeon when ascertaining the presence of fluctuation from above and below the annular ligament of the wrist by firm pressure alternately applied in this direc-

FIG. 418.



Ganglion involving all the flexor tendons of hand and wrist.

tion, the pressure exciting a peculiar rough scrooping sensaiton, caused by these loose bodies passing along the thecæ of the tendons beneath the ligament.

TREATMENT.—The local ganglion when first formed, may often be cured by the application of a blister and by rest of the tendon secured by means of some splint, but when it has existed for some time, such treatment is useless. When it can be ruptured by pressure applied by grasping the flexed hand with both hands and by one thumb superposed upon the other over the ganglion, a cure may often be effected; firm pressure being subsequently kept up by means of a pad of lint and strapping. When this fails, the ganglion should be punctured subcutaneously by means of a spear-shaped needle or fine tenotomy knife, its contents squeezed out, and pressure applied by lint and strapping as before. When success does not follow this treatment, a silk seton may be introduced, the hand being kept quiet on a splint, but it should be removed so soon as suppuration has been established. This treatment should not be employed, however, until all minor means have failed, for it is occasionally followed by diffused inflammation of the theca of the tendon with all its dangers.

The diffused or compound ganglion is dangerous to deal with; that is, any interference with it may be followed by severe inflammation of all the thecæ involved, and thus limb and life be jeopardized. But this result is not common when proper precautions are taken to guard against it. The risk of such a thing should always, however, be laid before the patient by the surgeon before any operation is arranged.

The only effectual way of dealing with it is by incision. To do this, the surgeon should for some five or six days before fix the hand and forearm upon a splint; he should then make a clean cut into the affected theca, free enough to allow of the ready escape of all the ganglion contents without any forcible manipulation. When many thecæ are involved, more than one incision is called for. The incision should always be made in a vertical direction over the tendons, and both above and below the annular ligament when the disease extends up the arm. After the operation, the wound should be dressed with water dressing and the splint kept on, movement of the finger being allowed after the lapse of a few days, when the fear of diffused suppurative inflammation has passed away. In the severe example of the affection illustrated in Fig. 418, this practice was adopted with success, and in several others of a less severe character, I could record the same result. I have never had occasion to divide the annular ligament.

CHAPTER XXIX.

DEFORMITIES, CLUB-FOOT, AND ORTHOPÆDIC SURGERY.

MALFORMATIONS.

MALFORMATIONS of the limbs remain to be considered, those of special parts having already received attention under other headings.

They may roughly be classed as being due either to *excess* or hypertrophy, or to *deficiency*.

Unnatural adhesion between parts is not rare, and mal-development in some odd way is occasionally met with.

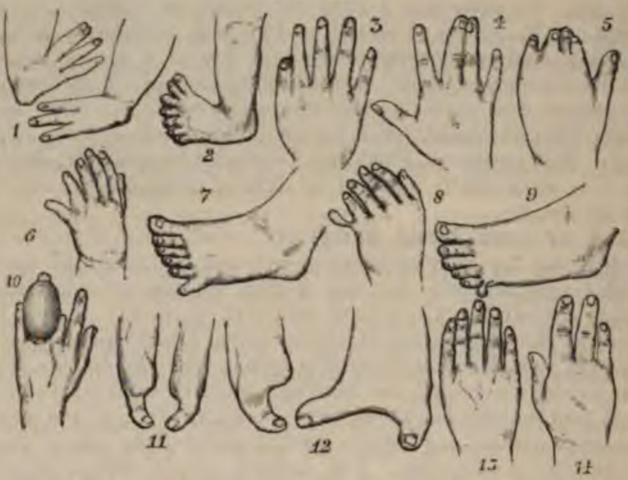
As examples of excess of development, supernumerary fingers or toes are the most common, the supernumerary digits being more or less well formed or rudimentary; appearing either as skin appendages (8, 9, Fig. 419) or being more like cleft phalanges, with common metacarpal or metatarsal bones (2, 6, 7, Fig. 419). The thumb is very commonly cleft.

Thus, out of twenty cases of supernumerary fingers and toes consecutively noted, eight were of the thumb, and four were of the fingers alone, three of the toes alone, and five of the fingers and toes together, the deformity being symmetrical in six of the cases. Occasionally supernumerary fingers or toes have perfect metatarsal or metacarpal bones, and more rarely the hand may be double. Jardine Murray, of Brighton, has recorded such a case ('Med.-Chir. Trans.,' vol. xlvi).

Hypertrophy of extremities is met with, either of whole limbs or parts of limbs. In drawing 10, Fig. 419, hypertrophy of one finger is shown, associated with deficiency of others, but the hypertrophy is a type of the affection that is met with in practice, whether of a digit or extremity.

TREATMENT.—Rudimentary fingers and toes may be fearlessly excised when they appear as skin appendages, but, when they exist as bifid phalanges, great care is called for in their treatment on account of the frequency of their being a common joint to the two digits. Under these circumstances, the surgeon should carefully consider the question of amputation; and if he decide upon performing it, it will be wise to cut off the supernumerary digit some little distance from the joint, leaving a stump, which, as a rule, subsequently withers.

FIG. 419.



Types of the different kinds of deformities of the hands and feet.

Hypertrophied extremities may be removed when they are sources of great inconvenience, but not otherwise.

Webbed fingers and toes are another common deformity. At times all the digits of one or both hands or feet are webbed, but more commonly only two are involved. Thus, I have seen the thumb and index-finger webbed in one case (No. 3, Fig. 419); the ring and middle fingers of both hands (No. 4), and in another the second and third toes of both feet. In one instance, the toes of one foot were webbed, and the fingers of the hands more or less truncated. In another, with webbed toes on both feet, there was a supernumerary right thumb. Indeed, where a disposition to deformities shows itself several varieties of deformity may co-exist in the same subject.

TREATMENT.—For the hand, when the fingers are well formed, the surgeon, if possible, should divide the web, but, under other circumstances, it is more prudent to leave it alone. When the web is very narrow there is nothing left but to divide it, but before doing so a good opening at the base of the cleft ought to be established to prevent the subsequent closure of the wound. This can be efficiently effected by means of the galvanic cautery or otherwise, and the subsequent introduction into the opening of a piece of aluminium wire, the wire being kept in till the wound has cicatrized and become as thoroughly established as an ear-ring hole. When this step of the operation has been effected, the cleft may be fearlessly divided.

When the web is broader and more material exists for the surgeon's manipulation, the best plan to adopt is, to split the web transversely between the fingers, and to turn one flap of skin round one finger and the other flap round the second, stitching the edges of the flap to the skin of the finger.

Webbed toes need no surgical interference.

Absence of parts cannot surgically be remedied. In No. 13, Fig. 419, there was an absence of a thumb, but by way of compensation, an extra finger was given. In No. 14, the ring-finger was absent, but the index and middle were hypertrophied.

At other times, limbs are truncated as if from intra-uterine amputation, and, in rarer cases, bones and joints seem to be deficient. Thus, in a male subject I had under care some years ago the right arm was shortened as if amputated above the elbow, and the right lower extremity was represented by one short bone, with a foot that would have been called perfect if the little toe had not been absent.

These cases are mentioned, however, only as curiosities, and are beyond the pale of the surgeon's art.

Clawlike extremities as represented in Nos. 1, 11, and 12, Fig. 419, are very curious. No. 1 represents the hands of George N—, æt. 7 weeks, the third child of well-made parents, the other children being natural. Very little power existed in the claws, one finger alone being of use. The child in other respects was well made and intelligent.

Nos. 11 and 12 were taken from Edward E—, æt. 4, one of eight children, three being boys and five girls, one brother having precisely the same deformity. The parents were well made.

The hands in No. 11, had apparently but three metacarpal bones; the wrist and carpal joints being normal; the solitary digit had much power. The feet in No. 12, were still more oddly made. In both, the tarsal bones seemed to be natural, but on the right foot the metatarsal bones were confused together. The digits had good power. Nothing could be suggested for the patient's benefit.

Hereditary nature of deformities.—The hereditary nature of deformities is generally recognized, though in the history of such cases it is exceptional for such a tendency to be traced. When, however, it is made out it is, as a rule, remarkable. Deformities, when inherited, are also generally of a like kind. Thus, deformities of the genital organs are passed on to succeeding generations, as is the disposition to harelip or webbed fingers, &c.

Exceptions to this rule are met with. Thus, in a family of twelve children, two out of four boys had harelip and fissured palate, and one out of eight girls had hypertrophy of the right lower extremity, with atrophy of the right great toe. The father of this family had a supernumerary little finger on one hand.

A female child, one of five, the other four being well made, had hypertrophy of the two inner toes of the left foot. They were at five weeks old as large as the toes of an adult, and as well made. The parents had no deformity, but the father's maternal grandfather had a double thumb.

A boy had a double thumb on one hand and a web between the second and third toes of both feet. His father had webbed toes.

These exceptions to the rule above given are, however, rare.

As illustrations of the rule, the following cases have been extracted from my note-books. A man had six perfect toes on each foot, and six perfect fingers on each hand. He was one of ten children, all of whom had the same kind of deformity. The parents of these children were, however, well made.

A female child had left equino-varus. She was one of eight children, the other seven being well made. The parents had no such deformity, but the mother had two brothers and one sister so deformed, and her father had double talipes.

A man had scrotal hypospadiasis, and was one of nine children. Both his parents were well formed, and no history of deformity could be traced backwards. One of his sisters had harelip, while two of his brothers were deformed as he was, one having passed as a female till he was eighteen years of age. Two other brothers and three sisters were natural, but each of these brothers had a son a hypospadiac.

These cases are very striking.

CLUB-FOOT.

When paralysis takes place of a single muscle or of a group of muscles functionally associated, the opposing muscle or group losing antagonism, acts uncontrolled, and, as a consequence, contraction or deformity is liable to be produced, the deformities resulting from this class of cases being designated *paralytic distortions*.

When a muscle or a group of muscles, from whatever cause, acts spasmodically with an active tonic contraction, or a slow and progressive one quite irrespective of the will, or but slightly influenced by it, and in this way overcomes the opposing muscle or group of muscles, deformities may likewise be produced, such cases being called *spastic* or *spasmodic distortions*.

In the first class, the degree of deformity depends much upon the degree of paralysis that is present, and in the second, on the amount of spasm or contracting force of the muscles involved. Some surgeons would class all deformities in the first group, but this view is incorrect.

Both may be *congenital* or *acquired.* In the congenital, greater changes take place in the conformation of the bones than in the acquired, these changes depending much upon the intensity of the muscular action, but more upon the period of life at which they commenced.

"It seems as if in congenital club-foot and analogous distortions a stimulus or irritant were present in the medulla spinalis, acting upon certain ganglionic cells there, which keeps the affected muscle in a state of tonic contraction, yet not sufficient to neutralise the stimulus of the will within the limits of movement permitted by the structural shortening of the member. Many non-congenital spastic contractions appear allied to the condition which prevails in some states of chorea, in which, when the will would permit or cause contraction or relaxation of a particular muscle, an involuntary influence excites contraction, interferes with and frustrates the voluntary effort. In more intense spasmodic contractions the will is entirely overpowered before structural shortening supervenes to effect the same end."—*Little.*

As an extra argument in favor of this view, the fact may be adduced that club-foot often coexists with other deformities, such as spina bifida and club-hand, &c. "Congenital and non-congenital club-foot spring from analogous causes."

When these muscular contractions are powerful enough or continue long enough to alter the natural position of a part, deformity is said to exist, and according to its seat or form has it a special name.

To Stromeyer abroad as well as to Little in this country, are we chiefly indebted for most of our knowledge on this matter, although in more recent times Tamplin, Lonsdale, W. Adams, Brodhurst, and others have added much to the subject.

Stromeyer, however, in 1831, only followed Delpech in 1828, this great surgeon following a greater—John Hunter—who in 1794 established the principle of subcutaneous surgery, when he divided injuries to sound parts into two divisions, and established this principle, that—"The injuries of the first division, in which the parts do not communicate externally, seldom inflame, while those of the second commonly both inflame and suppurate."

Club-foot may be divided into four typical forms:—

Talipes equinus, in which the heel is simply drawn up by the contraction of the muscles of the calf (Fig. 420).

FIG. 420.

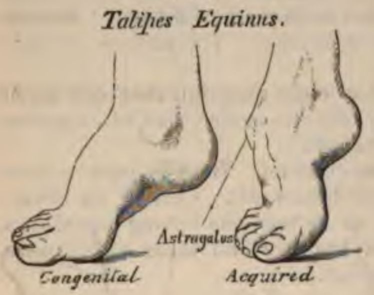
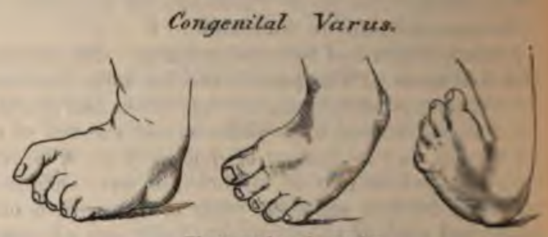


FIG. 421.



Three grades of severity.

Talipes varus, in which the foot is drawn inwards to different degrees (Fig. 421).

Talipes valgus, in which the foot is turned out (Fig. 422).

And, **talipes calcaneus,** in which the foot is drawn up and the heel depressed (Fig. 423).

Combinations of these forms are commonly seen, thus, we have *T. equino-varus,* when the foot is turned *in* and heel drawn up (Fig. 421A); *T. equino-valgus,* when the foot is turned *out* and the heel drawn up; *T. calcaneo-varus* and *calcaneo valgus* being terms applied when the heel is depressed and foot turned in or out.

Talipes varus is the usual congenital form, but any may exist, talipes equinus and equino-varus and valgus being the more common acquired forms.

In *valgus,* the peronei muscles are chiefly involved; in *varus,* the adductors, particularly the two tibials; in *equinus,* there is contraction of the muscles of the calf through the tendo Achillis; and in *calcaneus,* paralysis of the same group.

Club-foot is often hereditary, and more prone to attack the male branches of a family than the female, and in this respect seems to follow the ordinary law of all deformities. In a case under my care of talipes varus, the child's father, grandfather, and great-grandfather on the father's side had congenital talipes, while none of the female branches of the respective families were deformed.

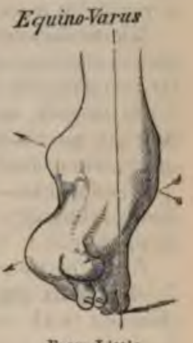
"It is convenient, for practical purposes, to divide congenital club-foot into three degrees of severity: the *slightest*, that in which the position of the front of the foot, when inverted, is such that the angle formed by it with the inside of the leg is greater than a right angle, and in which the contraction is so moderate that the toes can easily be brought temporarily by the hand of the surgeon into a straight line with the leg, and the heel be depressed to a natural position. The *second* class includes those in which the inversion of the foot and elevation of the heel appear the same or little greater than in those of the first class, but in which no reasonable effort of the surgeon's hand will temporarily extinguish the contraction and deformity. The *third* class comprises those in which the contraction of the soft parts and displacement of hard parts reaches the highest degree, so that the inner margin of the foot is situated at an acute angle with the inside of the leg, sometimes, or even almost in contact with it. Cases of the first and second grades may be respectively converted into the second and third grades by delay in the application of remedies, and by the effects of improper locomotion."—*Little.*

Talipes *equinus* is the most common form of the acquired talipes, although Little positively declares it is at times congenital. It is found in every degree, from the inability to flex the foot beyond a right angle to a pointing of the toes, necessitating the patient walking upon the heads of the metatarsal bones and phalanges, the head of the astragalus projecting prominently on the dorsum of the foot. Fig. 420 illustrates the medium and extreme forms.

Talipes *varus* is the more common congenital form. Fig. 421 illustrates it in three degrees of severity.

It is very frequently combined with T. equinus, as seen in Fig. 421A. The arrows in the figure indicate the direction of the convexity of the tarsus and metatarsus forwards and outwards; the perpendicular line through the axis of the limb shows the extent of the inward deviation of the metatarsus, by which the base of the little toe, being brought completely beneath the axis, has to support the entire weight of the body in walking.

FIG. 421A.



From Little.

Talipes *valgus* may be of all degrees of severity, and may be congenital or acquired, these two varieties presenting very different appearances. Fig. 422 illustrates the congenital form in two degrees of severity; and also the acquired.

Talipes calcaneus is illustrated in Fig. 423.

For a full detail of the anatomical changes of the foot under these different conditions, *vide* Adams in 'Path. Soc. Trans.,' vol. iii.

FIG. 422.

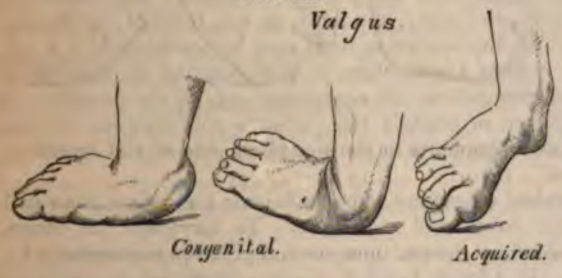
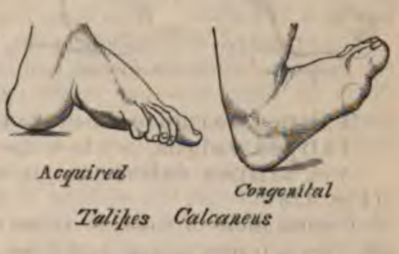


FIG. 423.



Before considering the treatment of these affections it will be well to look into the principle upon which all interferences must be based, and the process by which repair can take place after the division of tendon.

To Paget and W. Adams, in this country, we are chiefly indebted for our knowledge ot this subject, and I shall use as much as possible, Adams's description of this process as published in 1860, in his work on the 'Reparative Process of Human Tendons after Division,' his investigations having confirmed those of the former as well as added to our stock of knowledge.

When such a tendon as the tendo Achillis is divided subcutaneously, the divided ends separate, in an infant for half an inch, and in an adult from one to two inches, the degree depending on the healthy condition of the divided muscle and the amount of movement subsequently permitted in the ankle-joint.

The reparative process begins by increased vascularity in .the sheath of the tendon, which is followed by the infiltration of a blastematous material into its meshes or spaces between its fibrous elements, exhibiting the development of innumerable small nuclei, a few cells of large size and irregular form, with granular contents, or, perhaps, with one or more nuclei and studded with minute molecules of oil; a blastematous material, in which the cell forms do not develop beyond the stage of nuclei, appearing to be proper reparative material from which new tendon is developed. This nucleated blastema soon becomes vascular, capillary vessels having been seen in it on the eighteenth day; the nuclei assume an elongated, spindle, or oat-shaped form, and are seen after the addition of acetic acid to be arranged in parallel linear series. The tissue becomes gradually more fibrillated, and at last fibrous—a solid bond of union subsequently forming between the divided extremities of the tendon, which is tough to the touch, but to the eye presents, even for at least three years, a grayish, translucent appearance, distinguishing it at once from the glistening old tendon. This new tissue remains during life as permanent, and has little tendency to contract subsequently. Adams's observations rather led him to the conclusion, that the required portion of new tendon is to be obtained during a lengthened period of formation, that is, about two to three weeks, under the ordinary conditions of health; but, in paralytic cases as in others of feeble health, this period may be doubled.

Adams informs us also, that the divided extremities of the old tendon take no active part in the reparative process during its earlier stages, although at the later the cut ends become rounded and their structure softened. They become enlarged and exhibit a tendency to split, and thin streaks of new material similar to that already described are seen between the fibres; the ends are joined by these means. At a later period, the bulbous enlargement gradually diminishes.

When a tendon is divided a second time, there is but little separation of its ends, and this is probably due to adhesion of the new tendon to the neighboring fibro-cellular tissue, in which fact is found an explanation of the unsatisfactory results of second operations.

There is no reason for believing, that in the treatment of deformities by tenotomy, direct approximation and reunion of the divided extremities of the tendon must first be obtained, and that the required elongation is afterwards to be procured by gradual mechanical extension of the new connecting medium, as we would stretch a piece of india-rubber.

Gradual mechanical extension, however, is required, in cases of *long standing*, as in those of *congenital* origin, to foreibly overcome ligamentous resistance, and to separate the ends of the divided tendons; as it is in those of *paralytic* and of *non-congenital* origin to prevent the too rapid separation of the extremities of the tendon. The mechanical extension should be carefully regulated according to the activity of the reparative process, as indicated by the amount of effusion into the sheath. Blood poured out into the sheath or any inflammatory action interferes much with the process of repair; any causes of general feebleness, coldness of the limb, too early, too late, or too forcible extension, having a like effect. With these remarks the operation itself may be considered.

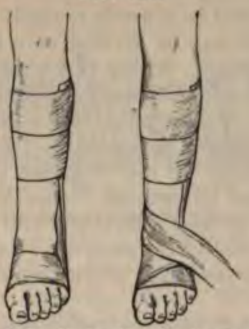
TREATMENT.—"The indications," writes Little, "are to overcome the shortening of the muscles, ligaments, fasciæ, and integuments on the *contracted side* of the member, to direct the bones into their proper position, to educate the patient's voluntary use of the parts, to give strength to the muscles and ligaments in the *elongated* side of the member, and to combat the tendency to relapse."

To fulfil the first indications, mechanical means are often sufficient; and when these fail or are inapplicable, the division of the contracted structures. To carry out the other, mechanical means are also of value, aided by general measures, and more particularly by galvanism of the weakened muscles. In a large number of cases, however, instruments are not required, much less tenotomy; since in any case of congenital or infantile talipes, when the foot can be brought into its normal position with but little force, a cure without operation can with some confidence be promised.

In the very simplest cases, mere friction of the affected limb and the daily extension of the contracted tendons is often enough to effect a cure, the nurse or parent holding the crooked foot for some ten or fifteen minutes two or three times a day in the required position.

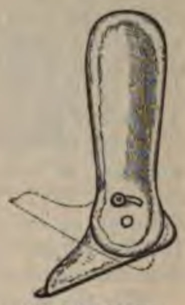
In the next class of cases, which are slightly worse than the last, in which the foot can be brought with gentle force into its natural place, a cure can be effected by means of strapping adjusted in the fashion depicted below (Fig. 424). The strapping must be

FIG. 424.



Mode of stretching foot in talipes varus by strapping.

FIG. 425.



Splint for talipes.

of a firm nature; that spread on linen being the best, as made by Messrs. Gerrard & Co., or Leslie, and used at Guy's. The first piece acts as a kind of splint, and the second by binding down the first to the ankle, admits of any amount of force required to bring the foot in or out, according to the nature of the case. In a still more severe form, where the former method is inapplicable, a small tin splint covered with leather with a screw hinge at the ankle, such as that advised by Little, or made for myself by Millikin, of St. Thomas's Street, may be employed, the foot being forcibly brought into the required position and fixed there by strapping (Fig. 425).

In the worst forms, where, by no ordinary force the foot can be brought into the required position, the division of the shortened tendon, tendons, or fascia should be performed, no more structures being divided than are absolutely essential.

"When deciding on the necessity of operation, the surgeon must not be guided solely by the external configuration, but by the amount of firm resistance opposed to restoration, by the depth of the furrows existing in the sole and behind and above the heel, and by the degree of tension of the integuments above the internal malleolus. The deep clefts or furrows in question denote intensity of contraction of muscles, and closer adhesion than usual of integuments and fascia to the subjacent soft structures and bones. They probably denote, also, that the deformity dates from an early period of uterine existence." —*Little.*

Sayre's law upon this point is very good: "Place the part contracted," he writes, "as nearly as possible in its normal position by means of manual tension gradually applied, and then carefully retain it in that position; while the parts are thus placed upon the stretch, make additional point-pressure with the end of the finger or thumb upon the parts thus rendered tense, and, if such additional pressure produces *reflex contractions*, that tendon, fascia or muscle must be divided, and the point at which the reflex spasm is excited is the point where the operation should be performed. If, on the contrary, the additional point-pressure does not produce reflex contractions, the deformity can be overcome by means of constant elastic tension, and the more you cut, the greater will be the amount of damage done."—'Orthopædic Surg.,' 1876.

In all cases treatment should be commenced *as soon as possible*, and the foot of the youngest infant may be dealt with advantageously by manual extension a few days after birth. Within a week, extension by strapping may be carefully employed, the foot being looked to daily to see that no sloughing or cutting of the skin by the strapping takes place, for in infants the tendons yield far more readily than they do as months or years go on, and with care no harm can accrue from simple mechanical extension. Even splints, carefully applied, can be used.

When tenotomy is clearly a necessity—that is, in grave deformities—there is no reason, in a healthy well-developed babe, why it should not be performed within a month after birth. I have divided the tendo Achillis for a talipes varus, with an excellent result at the end of the first week, and Mr. Stromeyer Little has operated successfully within twenty-four hours of the child's birth.

The operation.—In a large number of cases of congenital varus the division of the tendo Achillis is enough, the foot after division of the tendon being generally capable of restoration to the required position by mechanical means, but in severe examples, the anterior or posterior tibials, singly or together may require to be cut. These three tendons may be divided at one operation in average cases, though in the severe, Little's advice is good to deal with the tibial tendons first and overcome the inversion of the foot, and, at a later date, to divide the tendo Achillis. The value of this proceeding consists in the fixed os calcis offering a resisting point from which the surgeon is enabled to stretch out and unfold the contracted inverted sole.

Division of the tendo Achillis.—The patient should be turned on the abdomen, and the tendon made tense by means of an assistant. The surgeon should then insert a sharp-pointed or round knife flatwise from behind forwards by the side of the tendon as far as its anterior surface, when it should be turned laterally in front of the tendon and its cutting edge directed backwards towards the tendon, when, with the slightest sawing motion, the tense cord may be divided, care being observed to do this completely or failure will follow. The surgeon, during this procedure, should keep his finger upon the tissue to be divided, and immediately on the withdrawal of his knife, close the opening with his finger or thumb, the assistant relaxing the parts at the moment he feels resistance to cease. A dossil of lint should then be applied to the puncture and fixed by strapping, this dressing being left for three days. If any suspicion exist of the posterior tibial artery having been wounded, as indicated by arterial hemorrhage and blanching of the foot, the dressing should be left on for at least a fortnight and all mechanical treatment postponed. It is, however, an exceptional circumstance for any harm to follow the puncture of the artery. Little, with all his experience, informs us that he has only once seen any trouble from this circumstance.

After the operation the foot in its deformed position should be bound to a flexible metal splint till the immediate effects of the operation have subsided, after which the mechanical treatment may be commenced.

Division of the posterior tibial tendon should be performed with the child upon its back, with the limb to be operated upon rotated well outwards. The surgeon should take charge of the foot and his assistant of the knee. The tendon should be divided about one inch, or one and a half inch above the extremity of the inner malleolus. In thin subjects, on abducting the foot, the tendon may be felt at the spot indicated; but in fat persons, and when the tendon cannot be made out, the surgeon knows it lies along the inner edge of the tibia, "exactly midway between the anterior and posterior borders of the leg on its inner aspect."

At this spot the knife should be inserted perpendicular to the surface through the fascia for about half an inch, this opening in the fascia being made sufficiently free to admit of the introduction of the probe-pointed knife, which must next be inserted. This knife can then be introduced perpendicularly close to the bone, between it and the tendon to be divided, when its edge should be turned towards the tendon and the operation completed by a slight sawing movement. It is not always necessary to change knives during this operation, some operators, indeed, never do so. It is safer, however, to adopt the practice in fat subjects when some uncertainty exists as to the exact position of the tendon. As soon as the tendon has been divided, a dossil of lint should be applied, as in the former operation.

Some surgeons prefer to divide the tendon of the long flexor muscle at the same time; as a rule, this is unnecessary.

Division of the anterior tibial tendon can be performed with the patient lying on his back and the foot extended, the tendon being in this way made prominent in front of the inner malleolus. The knife should be inserted at this point behind the tendon and its edge turned forward, when the tight cord can be divided—the foot being at once flexed, and the punctured wound covered with lint and strapping. It ought to be kept in a splint for several days, after division of the tendo Achillis.

When all these tendons are divided at the same operation, the after-treatment must be the same.

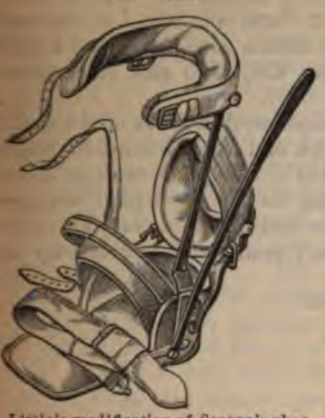
Division of the peronei tendons for talipes valgus is easily accomplished by adducting the foot and introducing the knife behind the external malleolus, between the tendons and the fibula—the tendons being cut on turning the edge of the knife towards them with a sawing movement. Some surgeons advocate a higher division of these tendons to obviate their retraction, union taking place between the tendon and the sheath.

It is unnecessary to describe the operation for division of the *plantar fascia* or other tendons, as the practice in all should be conducted on principles identical with those already described.

Mechanical Treatment.—However necessary these operations may be in any given case, it ought to be remembered that they are only preparatory to the mechanical treatment of stretching which is subsequently to be carried out. That they are not always necessary has already been shown, mechanical treatment generally being amply sufficient of itself to effect all the surgeon desires.

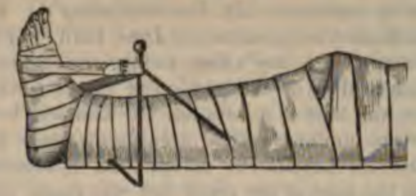
In one case after the division of the rigid tendon or tendons, a cure may be effected by means of strapping as already illustrated (Fig. 424); in a second, a simple inside or outside splint with strapping or bandages may be enough. In a third the simple splint figured in Fig. 425 answers every purpose; while in a fourth, Scarpa's shoe is required

FIG. 426.



Little's modification of Scarpa's shoe for talipes.

FIG. 427.



Mr. Davies-Colley's splint for talipes equino-varus.

(Fig. 426), or some of its modifications. A shoe with a ball-and-socket heel-joint, which Messrs. Krohne made for me, is strongly to be recommended, and in Fig. 427 is another, suggested by my colleague Mr. Davies-Colley, which, for extreme examples of talipes, is inexpensive and stands unrivalled.

In all, the principle embodied is the same, the separation of the divided ends of the tendon and the deposition of new material between them. The splint invariably should be applied and fixed to the foot in its deformed position, and the stretching process commenced on the third or fourth day, and be completed at the latest by the second week. In many I have brought the foot into position on the third or fourth day, and with nothing but good results. Delay in this matter, as a rule, means failure, for the new tissues soon assume a fibrous character, and the deposition of new material takes place only during the early days after the operation. In adults, however, the mechanical treatment may extend over many months.

If failure follows the first operation, a second may be performed, but the hope of a successful issue under these circumstances is far from good.

Barwell has recently revived the old practice of elastic bands to stretch the tendons in lieu of dividing them; and in some cases it is a valuable practice, but as a substitute for tenotomy it cannot be recommended.

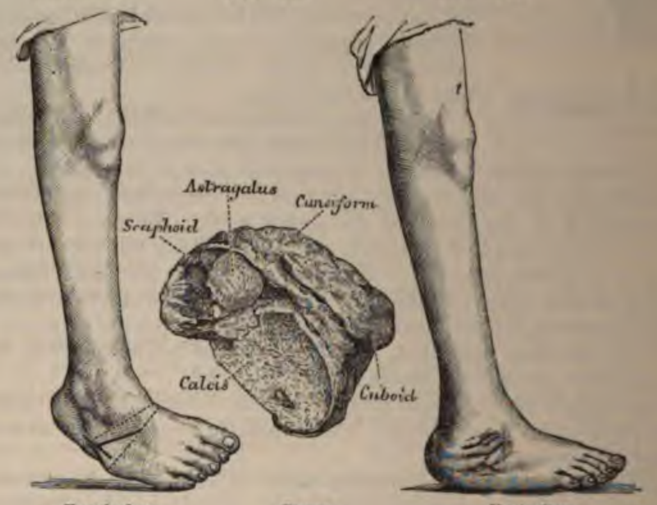
There are, however, cases of talipes equino-varus which are neither amenable to subcutaneous tenotomy nor to mechanical appliances, as well as others which have been treated by these measures and have failed, or which are so severe as to make it certain that a long interval of time must of necessity be spent in the attempt to bring about a cure, even if such a result were probable or possible; and under these circumstances surgeons have sought for more expeditious and efficient means of treatment. With such a view, Dr. Little, the pioneer of tenotomy in this country, suggested, so long ago as 1854, "that in inveterate varus the treatment might well be commenced in robust subjects by ablation of the os cuboides," and the late Mr. S. Solly, in 1857, carried the suggestion into effect. The case not proving very successful, the practice met with no encouragement, and the operation was not repeated till Mr. Richard Davy, an old pupil of my own, performed it at the Westminster Hospital in 1874, on a boy, æt. 15, with such a "striking immediate result that the sole of the foot could with force be placed in a natural position," and he repeated it in 1875–76. In 1872, Mr. Edward Lund went a step further, and removed from a boy, æt. 7, both astragali in a case of severe double talipes, with some perceptible improvement. This measure he repeated in March, 1878.

In October, 1875, however, my colleague, Mr. Davies-Colley, adopted a new method, and on the suggestion of Mr. Howse, removed from a boy, æt. 12, a wedge-shaped piece of the tarsus without paying any regard to its articulations, by means of "an incision, three inches in length, along the outer border of the left foot, from the middle of the os calcis to the middle of the fifth metatarsal bone, and a second across the dorsum of the foot from the centre of this incision two inches long. Both feet were operated upon at intervals of six weeks, and in less than ten weeks from the second operation the wounds were quite healed, and the boy could walk without assistance. In November, 1876, Mr. Davy performed the same operation.

All these proceedings are sound in principle, and in cases of talipes in which minor measures have been tried and have failed, or in which the probabilities of their success are slight, and time and expense are questions of importance, they should be entertained. I believe, however, that Mr. Davies-Colley's operation is the best for talipes equino-varus, particularly where the varus is worse than the equinus, though Mr. Lund's operation is probably of value under the reverse conditions. I say this after having had opportunities of seeing several of Mr. Davy's and one of Mr. Lund's cases and having carefully watched throughout its treatment Mr. Davies-Colley's. Entertaining these opinions, I performed Mr. Davies-Colley's operation on June 18th, 1878, and with such a good result that I now give drawings of the boy's foot before the operation[1] (Figs. 428, 429) and subsequent to it with an outline of the portion of bones removed (Fig. 430).

The case was that of a boy, æt. 12, who was born with talipes equino-varus of the right foot, and went under surgical treatment when eight months, and again when five years old, but with no permanent relief. On admission into Guy's, under my care, on June 12th, 1878, the heel of the right foot was much drawn up, and the foot so twisted inwards as to cause the sole of the foot to face the median line of the body, as in a complete sub-astragaloid dislocation. The head of the astragalus was very prominent, and the tip of the inner malleolus approximated the base of the metatarsal bone of the great toe, the tubercle of the scaphoid being buried in the abnormal depression. By no force could the foot be restored to a better position, although the tendo-Achillis and tendon of the posterior tibial muscles could be made tense. Under the circumstances described it was tolerably clear that by no tenotomy or mechanical means could any hope be entertained of restoring the foot to a good position, and I consequently determined to perform Mr. Davies-Colley's operation.

Fig. 428. Fig. 430. Fig. 429.



Foot before operation. Bones removed. Foot after operation.

This I did on June 18th, 1878, by an oblique T-incision of the soft parts, and the application of a keyhole saw beneath the tendons and soft parts, made after Esmarch bandages had been applied as a tourniquet.

The wedge of bone I removed is represented in Fig. 430, and was taken out entire, great care being taken to protect the tendons and soft tissues and particularly those of the sole, by the introduction of a flat retractor, during the sawing process.

The day following the operation the temperature went up to 102.4°, but fell the next day. On the third day, when the wound was dressed for the first time, it was 99.6, and during the progress of the case it never deviated beyond a point or so from that degree. On July 11th, the bones having fairly united and the wound nearly closed, Davies-Colley's talipes splint was put on and the limb swung.

On Sept. 10th the boy get up, and the sole of the foot was found, on his standing, to be perfectly flat. An immovable splint was then applied, and the boy left for the country. On October 20th he returned to have the tendo Achillis divided, with the view of giving more movement to the ankle-joint, and some success has followed the measure. He can now (November 10th) walk fairly well, with his foot as flat to the ground as the unaffected one.

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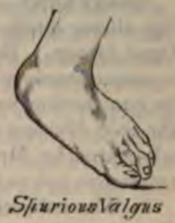
[1] The delay arising from the accidental loss of the MS. of this article during the printing of this work affording me the opportunity of inserting the case.

Spurious valgus, or flat foot.—This requires a notice, as it is a common condition and causes much distress. It is found in growing boys and girls who stand much or take too much exercise, and is the direct result of the giving way or yielding of the ligamentous and fibrous structures of the sole of the foot (Fig. 431 ;)the arch of the foot sinks, the foot and toes become everted, and the peronei muscles contract as a secondary consequence. In extreme cases the movements of the ankle-joints are likewise seriously interfered with.

FIG. 431.



When slight, the deformity can readily be remedied by simply giving rest to the weakened tissues, forbidding standing, and allowing only gentle exercises; also by the use of tonics, &c., during the growing period of life. Mechanical support by means of strapping, in some cases gives great comfort and does good.

In a worse class, the introduction of a light steel plate as a support in the hollow of the boot is of great benefit.

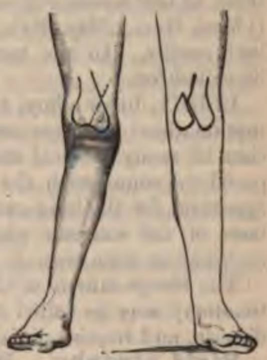
It is only in very neglected cases that tenotomy can be called for, and this not as a curative means.

In examples in which much pain exists, nothing but absolute rest will be of any use; and in such the local signs of inflammation of the overstretched parts can often be read, when fomentations, &c., may be employed.

Knock-knee, like flat-floot, is primarily due to the mechanical yielding of the ligaments of the knee-joint from want of power, but at a later date to the overgrowth of the inner condyle of the femur, from the want of the controlling influence of pressure which normally is applied through the leg bones. It is found in growing boys and girls who stand too much or carry heavy weights, and in those of feeble power either from natural or acquired causes. It is not rarely seen with rachitis.

It can be treated on principles based upon the facts just briefly stated, and not purely by mechanical means. To put irons on the limb of a feeble subject is a mistake, for where the child is too weak to support his own frame without injury, to give him more to carry must be hurtful. Young children should be taken off their legs as much as possible, and provided with proper food and such tonic medicines as seem requisite. The weakened ligaments should have time given them to contract and become strong. Other children should be limited in the amount of exercise; rest and exercise alternating at regular intervals. When walking half an hour causes pain or aching, something less should be allowed, and so on. Exercise sufficient to get and keep the muscles in order may be allowed, but not sufficient to tell upon the weakened ligaments. In other cases, as an additional means, strapping the knees may be of great use; in extreme cases only splints or irons should be employed. These latter instruments when used, should extend from the pelvis to the foot, and be well jointed. Double splints are of little use in these cases, as in the simple they are not wanted, and in the severe they are useless. In *very severe* examples operative interference may be justifiable. In the 'Edinburgh Med. Journal' for April, 1877, Dr. Ogston reports a case in which by means of Adams's saw he divided vertically and subcutaneously the inner condyle of the femur (*vide* Fig. 432), and so forcibly straightened the bent limb with the best result. The operation has been repeated eighteen times since, with good results. When the knees give out instead of in from the same cause, similar principles of practice are applicable.

FIG. 432.



Drawing illustrating Dr. Ogston's operation. *Right* limb shows line of section of the inner condyle of the femur. *Left*, inner condyle brought to required position.

Besides all these recognized affections there are many other conditions in which tenotomy is a valuable operation. Thus, in the contracted limbs which are associated with hip, knee, or other joint disease, it is often necessary to divide the rigid and contracted tendons or muscles that forbid the limb being straightened by the application of any ordinary or justifiable force; while mechanical means can then complete the object the surgeon has in view. It is better to divide than to tear a tendon.

Contractions of the fingers.—In this affection where the flexor tendons and the palmar fascia together produce a permanent contraction of first one and then the other finger so as to draw them into the palm, some operation is called for.

This affection is curious, generally appears in the little finger, subsequently involving the ring finger. It often attacks both hands, together or consecutively. It is said to be found more frequently in gouty or rheumatic subjects than in others, but I have failed to verify this statement. It is also difficult to trace the origin of the disease to any local injury; in fact, this affection is somewhat obscure. It may attack the middle finger or any and all of the fingers, but more commonly it is the two outer. From its symmetry it has probably a constitutional and not a local origin. It is often hereditary, but possibly not more so than any other deformity.

TREATMENT.—By fixing the contracted fingers in a flexible splint and gradually stretching them, much may be done, and in several cases I have effected a complete cure by these means. But it is difficult for men patients to submit to this inconvenience, and, as a consequence, the surgeon is only consulted when the disease is severe and the finger by its contraction has become useless, if not worse than useless. Under these circumstances, the free division subcutaneously of all the tense tissues may be called for, as recently ably advocated by Mr. W. Adams ('Brit. Med. Journ.,' June 29th, 1878). His operation and treatment are as follows:—

1. The subcutaneous division of all the contracted bands of the palmar fascia and its digital prolongations by as many punctures as might be necessary, cutting from above downwards, with the smallest tenotomy knife.

2. Immediate extension of the contracted fingers. The fingers and hand to be bandaged to a splint.

3. The bandage not to be removed until the fourth day, when the punctures will be found to be healed.

4. Extension splint to be worn night and day for two or three weeks, and afterwards at night for three or four weeks, motion being employed every day.

Dr. Madelüng, of Bonn ('Berliner Klinische Wochenschrift,' No. 15, 1875), believes that this condition of finger known as Dupuytren's contraction, is due to the absorption of the numerous small deposits of fat which in healthy young and middle-aged subjects exist between the connective-tissue bands of the palmar fascia and the short fibres which connect this fascia with the superjacent integument. This fascia, consequently, under the influence of pressure, falls into a state of chronic inflammation and becomes contracted. He then describes how Busch, of Bonn, treats such cases with great success. In a case, for example, of contraction of the little finger, he raises an angular skin flap from the palm of the hand, its base being at the root of the finger, and then cuts away bit by bit the tense fascia beneath as the finger is being straightened. He then replaces the flap and fixes it with sutures. The finger is left free for some days after this operation, but as soon as granulations appear, a cylinder of wood is placed in the palm for a few days, and after this the finger is extended and kept so by means of a straight splint applied to the back of the hands. This should be removed daily and the finger moved. At the end of three or four weeks the hand is left free. Dr. Madelüng has never seen this operation fail ('Med. Rev.,' May 26th, 1875). I have adopted this practice in several cases with excellent results. In the same way, one or more toes may be so affected, and tenotomy may be called for.

In 1871, I saw a boy, æt. 14, who for years had had repeated attacks of pain and inflammation about his great toe, more particularly after over-walking. He had been under the care of many medical men who had treated him for gout, &c., but who had never compared the sound with the affected toe. When I did this the source of the evil was very apparent, for the long extensor tendon was clearly contracted, and at its insertion into the base of the extreme phalanx there was much thickening. I divided the tendon, and recovery at once ensued.

The biceps muscle of the arm is also at times so contracted as to prevent extension, and tenotomy may be called for. In fact, any tendon may contract under the influence of disease, and require division.

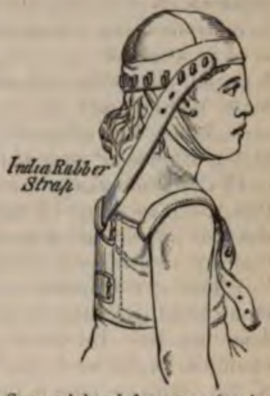
Rigid atrophy.—Muscles that atrophy occasionally contract and become rigid, but this rigidity must not be mistaken for the spasmodic contraction of a muscle or group of muscles that is so common in progressive disease, more particularly of joint disease, although it often follows upon that form; indeed, it seems generally to be the consequence of some long-continued spasm, atrophy following from exhaustion, inflammation of the muscle, or what is called rheumatism. It is seen more commonly in the flexor muscles of joints than in any other, and, as a special affection in some cases of *wry-neck*, where the sterno-mastoid muscle is at fault.

TREATMENT.—When the muscles are not too rigid, much may be done by rapid extension under the influence of chloroform, or gradually by means of splints, manipulation, or india-rubber bands, &c., suited to the wants of the individual case. When these means are ineffectual, or the parts too rigid to allow of their application, the subcutaneous division of the tendon of the muscle or muscles may be performed upon the same principle as tenotomy is practised in contracted tendons.

Wry-neck is an example of this affection due to a contracted sterno-mastoid muscle. It may be that the sternal or clavicular origin may be alone at fault, it being exceptional to find both divisions of the muscle affected. Under such circumstances, when the muscle refuses to be stretched by mechanical appliances, the half involved alone requires division, followed by extension when union has taken place. In these difficult cases it seems wise, as a rule, not to bring the divided ends of the muscle so closely into contact as the surgeon usually does after division of a tendon.

One of the worst cases of the kind I ever had to treat was in a child, æt. 7, in which both origins of the muscle required division. I brought the head up to the required position on the second day, and kept it there, an excellent result ensuing. In another which I treated in 1870, in a child, æt. 6, with Mr. Duke, of Battle, the muscle of the left side was two inches shorter than that of the right from contraction of its sternal half; I applied extension on the third day, after the division of the contracted portion, and brought the head into its right place, keeping up the extension by means of a piece of india-rubber band an inch wide, which was fastened to a skull cap on the opposite side of the head and passed backwards across the shoulders and beneath the axilla of the affected side to fasten to a good thoracic belt (Fig. 433).

FIG. 433.



Cap and band for extension in wry-neck.

These cases of wry-neck due to contraction of muscles, are always associated with some arrest of growth in the upper and lower jaws on the affected side.

Mr. De Morgan informs us ('Med.-Chir. Rev.,' 1866) that in a case that failed to yield under such treatment he took away a piece of the spinal accessory nerve with permanent benefit, the sterno-mastoid and trapezius muscles being of necessity paralyzed. This operation has been repeated, but without success.

The *operation* of dividing the sterno-mastoid muscle either wholly or in part at its sternal or clavicular origin, must be subcutaneous, and requires much care, for important parts lie behind the muscle which may be injured. A punctured wound should be made over the part to be divided with a sharp-pointed tenotomy knife down to the muscle; a blunt-pointed knife ought then to be introduced with its edge turned towards the muscle close to its bony attachment, and all resisting fibres divided by turning the edge backwards, an assistant putting the muscle fully on the stretch; the muscle usually gives way with a distinct snap. The thumb or finger must then be applied to the part, and a pad adjusted, sufficient pressure being made to prevent bleeding, but no more. As already stated, extension should be made early in the case, after the second or third day, and the means adopted in the example quoted seems to be the best; it succeeded at any rate, where the usual instruments failed.

When both insertions require division, it should be effected by two different punctures. Some surgeons prefer to divide the muscle from behind forward, but there is greater risk of injuring the deep parts by this practice than by the one advised.

I need scarcely add that where wry-neck is due to spinal disease, no such treatment as the above is applicable.

CHAPTER XXX.

CONTUSIONS, SPRAINS, WOUNDS, INJURIES OF JOINTS, AND DISLOCATIONS.

Sprains may be very slight or very serious injuries, and are more or less severe overstretchings if not lacerations of the ligaments that bind the bones of an articulation together. In the more severe instances are included lacerations of the muscles, tendons, and soft parts that surround the joint without displacement of the bones. They require rest and time in their treatment in order that repair may be complete; since neglected sprains are often the cause of joint disease.

Contusions of joints ought always to be regarded in a serious aspect, for a large amount of internal injury may often be sustained with very slight external evidence of mischief, and, under certain conditions of health, a slight blow or sprain is often enough to set up severe local action or to excite chronic changes which may involve the integrity of the joint. During the period of the growth of bone in children, these observations have great force. The nature of the accident and the amount of force concentrated on the joint is the best index to the case, and, under all circumstances, the prognosis should be guarded and the treatment cautious.

TREATMENT.—"In sprains of joints, rest is the first principle," said John Hunter in 1787 (MS. Lectures), and at the present day the same words are as pregnant with truth as when first spoken; indeed, in simple cases of sprain, by such treatment alone will convalescence be established. When swelling and effusion into the joint ensue in the course of the second or third day after the accident, the evidence of internal injury is more marked, for such effusion means inflammation or synovitis, which is to be treated by absolute rest, possibly by the application of a splint, the local use of ice, or cold lotion, leeches, or warm fomentations, according to the comfort afforded by cold or warmth.

If swelling of the articulation follows immediately upon the injury, effusion of blood into the joint is indicated with or without fracture, but always with severe local mischief. Such cases should be treated by the employment of a splint to insure immobility of the articulation, elevation of the injured joint with the patient reclining, and the local application of a bag of pounded ice, or irrigation with cold water; these means being maintained until the hemorrhage has ceased, all risks of inflammation of the joint gone, and repair appears to be going on satisfactorily. As soon as the primary effects of the sprain and all signs of inflammation have passed, the application of pressure to the joint by means of a bandage or strapping with passive movement is very striking.

When the muscles over such a joint as the shoulder are severely bruised by a fall, much local pain may be produced, as well as want of power in the arm exciting a fear of some bone or joint mischief; but a careful examination will show, if no roughness in the examination be used, that the joint can be passively moved without exciting pain, although if the patient attempts to set the muscles in action, pain is produced. This point is one of clinical importance, indicating that the mischief is in the muscle and not in the articulation, the pain being excited by muscular action and not by joint movement.

In delicate children, all falls upon the hip followed by pain should be treated by rest and extreme care; for a large number of cases of hip disease originate from some such slight cause, and there is good reason to believe that the majority of hip-joint affections might be prevented by proper attention after slight injury.

When the immediate effects of the sprain have passed away, the local use of some stimulating liniment and moderate friction of the part expedites the cure, and, at the same time, gives comfort to the patient. A local warm bath at intervals likewise relieves the stiffness of the joint. Whenever movement excites more than a momentary pain, rest should be observed; and if the pain continue, some chronic inflammatory change ought to be suspected and treated. When weakness of the joint alone remains, a good bandage or strapping around the part to give support is of great benefit. Where much laceration of ligament has taken place, it is at times necessary for the joint to have some permanent artificial support, either in the form of a splint, felt, leather casing, or bandage, for no parts are repaired with less permanent power than ligaments.

In the wrist, when much swelling exists, a sprain may be mistaken for a fracture or a fracture for a sprain, as fractures about the end of the radius are generally impacted, and not consequently attended by crepitus. Much care is necessary in the diagnosis of such cases. Many sprains of the ankle are also really cases of fracture of the fibula above the malleolus. The popular notion that a severe sprain is worse than a fracture is in the main true, and, when the sprain is neglected, the case is always more tedious than that of a broken bone.

WOUNDS OF JOINTS.

These are always serious accidents, yet, as a whole, if treated with discretion and at an early period of their existence, they are fairly successful in their issue. Lacerated, incised, and punctured wounds are met with, and the symptoms that follow any one of these accidents are by no means commensurate with the extent of the local injury, for a slight or punctured wound is often followed by severe and destructive local changes, when an extensive one heals without giving rise to any mischief.

A joint is known to be wounded when its contents escape, as synovia has very definite characters, its oily, glutinous nature rendering its flow very manifest. In fat subjects wounds over joints give exit to oily fluid, simulating "joint oil;" such fluid, however, is not sticky when rubbed between the fingers as is synovia. Yet joints are sometimes wounded without any evident escape of their contents, and doubtful cases are clinically to be treated as cases of wound. In every case of wounded joint however trivial, and in all doubtful cases of wounded joints, the *prognosis* must be very guarded and the *treatment* cautious.

TREATMENT.—The wound should be well cleansed with warm water, and its edges accurately adapted with sutures when necessary. Probing must be avoided and the joint should be kept in absolute repose, the application of a splint being desirable. The best local application is ice or cold-water irrigation; nothing checking pain or subduing inflammation and effusion better than the constant flow of cold water over the part. The cold, however, to be of value must be persistently applied, as any intermission of its use is almost sure to be followed by increase of pain and effusion. To seal hermetically a wound with a piece of lint soaked in the compound tincture of benzoin, and at the same time apply an ice bag is excellent practice. Should an interval have passed between the receipt of the accident and the application of the cold, and much joint inflammation exist with constitutional symptoms, the application of leeches to the joint, and subsequently of cold, is beneficial. In exceptional examples, where cold is not tolerated, warm fomentations must be substituted. The advocates of the "spray system" speaks highly of the plan of applying carbolic acid dissolved in oil to the wounded joint, and lint saturated with the same over the wound. Opium is always of use, the patient being kept fairly under its influence by one grain two or three times a day. Mercury is useless. In very sthenic cases, antimony may be given, and colchicum where gout is suspected.

When all acute symptoms have subsided and chronic effusion remains, the application of a blister or blisters expedites the absorption of the effused fluid, and the benefit of pressure by the adjustment of well-applied strapping is very great. In feeble patients, tonics are required. Should suppuration appear, active treatment is called for, such as a free incision into the joint, or other means which will be considered under the head of suppurating joints.

Extensive wounds of large joints complicated with other injuries had better be treated by amputation or excision.

DISLOCATIONS.

A joint is said to be dislocated when the articular surface of one bone is displaced from another, and, when the bone is wholly displaced, the dislocation is called "*complete*," but when otherwise, "*partial*" or *incomplete*. When a wound communicating with the joint complicates the case, it is known as a *compound* dislocation, and when not so associated, as a *simple* one.

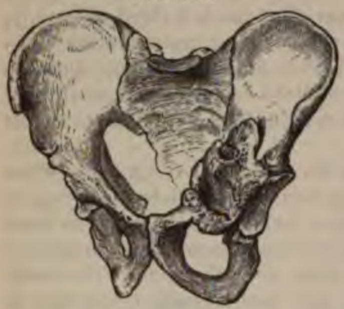
Congenital dislocations are cases of malformation, and the displacements of bones produced from disease are accidental complications of a more serious affection. In the present chapter neither of these two conditions will receive attention.

Dislocations are mostly caused by external violence, but they occasionally occur from muscular action. Dislocation of the lower jaw is the most familiar illustration of this fact. I have known, however, the head of the humerus to be displaced by the exertion used in the violent throwing of a stone, and by the spasm of muscles in an epileptic fit. I have, likewise, seen the hip-joint dislocated by mere muscular action. Schoolboys are also familiar with the dislocation of the thumb at the carpal joint, which some young persons who possess relaxed ligaments are capable of producing at will.

Laceration of the ligaments more or less complete as well as of the capsular ligament, is a necessary accompaniment of all dislocations, the muscles and soft parts that surround the injured articulation being likewise generally much torn. At times the nerves are pressed upon or lacerated, as at the shoulder, and the main artery may be divided in severe injury at the knee-joint. In all joints, more particularly in the ankle, dislocation may be complicated with fracture.

After a dislocation has been reduced, most of these injuries are steadily repaired, although some weakness of the joint often remains, but when nerves have been injured, more or less local complete paralysis or want of power follow in the muscles supplied by the injured nerves.

FIG. 434.



False joint after dislocation of the head of the femur. From Sir A. Cooper.

When a dislocation has been overlooked or neglected, other secondary and in a measure reparative changes take place and a new joint is formed. To effect this, inflammatory products are poured out around the bone in its new position, which organize and ossify (Fig. 434). The cavity thus formed becomes lined with a dense layer of fibrous tissue, putting on the external aspect, and serving instead of cartilage. The head of the bone becomes at the same time altered in shape, and surrounded by the condensed cellular tissue of the part, which answers for a new capsule. A large amount of mobility is often secured, particularly in the ball-and-socket joints. When, however, the original articular cavity becomes gradually filled in with fibrous tissue, the muscles, tendons, and soft parts that have been torn or misplaced make fresh attachments, and ossific matter is deposited in the tendons. The mobility of joints after dislocation is at times impaired.

How long these secondary changes take to form is not yet decided. In some patients they doubtless occur rapidly and in others slowly, as Brodhurst and Fournier both ('St. George's Hosp. Rep.,' 1868) record a case in which the cartilage of the acetabulum was found healthy, and the cups unfilled, three years and ten years respectively after a dislocation. Cadge also records a singularly instructive example ('Med.-Chir. Trans.,' vol. xxxviii) of an unreduced dislocation of the head of the femur upwards between the two anterior spinous processes of the ilium of sixteen years' standing, in which "the new bone was deposited in such abundance that it formed a new and complete acetabulum, so complete as, indeed, to hold the thigh bone suspended after all the soft parts were removed, and make it requisite to saw off a large piece of the new bone in order to set the femur at liberty. The new cavity, thin at its walls and smooth on its outside, was lined by a dense pearly-white tissue which resembled fibro-cartilage. The head of the femur was still covered with cartilage. The old acetabulum had disappeared, partly by the absorption of its cotyloid margin by a deposit of new bone, and partly also by a mass of dense fibrous tissue."

Diagnosis and Symptoms.—Typical examples of dislocation when seen at an early period of their existence are not difficult of diagnosis; although partial and even complete dislocations, some days after the accident, when swelling of the parts has taken place, are often obscure. The frequency with which such cases are overlooked, even by good men, forbids our saying they can always be made out.

In every case of suspected dislocation, the surgeon should compare the sound with the injured side, as in doing this, he will at once detect the most obvious result of any dislocation, deformity, and be able to make out the direction the displaced bone has taken. He, moreover, will see whether the limb is longer or shorter, or more abducted or adducted than its fellow.

The patient will not only have lost all power of voluntary movement, but the surgeon, by grasping the affected extremity, will probably find when dislocation exists, that the movements of the joints are very limited, and the attempt to move it causes severe pain. There will also be an absence of crepitus, unless some days have passed since the accident, when the crepitus of effusion into the joint or into the bursæ about the joint or tendons, will often be felt. *Deformity, loss of the power of voluntary motion*, and *impaired actual mobility*, coming on after an accident, are the three most marked symptoms of dislocation. Indeed, these symptoms by themselves, with the absence of crepitus, are usually enough to enable the surgeon to diagnose a dislocation from a fracture, although possibly they are not enough to distinguish it from the separation of an epiphysis. In subjects under the age of 21, the possibility should be entertained of any case of injury about a joint being due to some separation of an epiphysis or complicated with it. With respect to the diagnosis between the separation of an epiphysis and dislocation Holmes, with his usual clearness, writes upon this point ('System,' vol. v): "Separations of epiphyses are distinguished from dislocation by the following characters:—(1) The former can only occur at ages at which the epiphyses are separate from their shafts, the latter at any age. (2) The former are, as a rule, easy to reduce and difficult to retain; in the latter, as a rule, these conditions are reversed. (3) In the former, the points of bone immediately surrounding the joint preserve their normal relations; in the latter, these relations are variously altered.

(4) The sensation perceived in the two injuries is different, for separation of an epiphysis is usually complicated with fracture, and therefore crepitus can be elicited."

TREATMENT.—In all cases, the reduction of the dislocation should be effected as soon as possible, delay being only justifiable when the appliances required for the purpose are not at hand or the diagnosis uncertain. Most dislocations, not excluding those of the hip, may be readily reduced directly after their occurrence by extension or manipulation without the aid of an anæsthetic; but, when any time has been allowed to pass and the immediate constitutional effects of the accident have subsided, it is a fair question whether it is advisable to attempt reduction before anæsthetizing the patient; for, under the most favorable circumstances, without this aid, much force will to a certainty be called for, whilst with it the gentlest manipulation is often enough. Indeed, I believe it to be wiser for the surgeon to delay any attempt to reduce a dislocation till an anæsthetic can be obtained than to make it without, for the slight harm that ensues from the delay is more than compensated by the great good secured by its use. In no department of surgery is the benefit of anæsthetics better demonstrated than in this, for where force formerly reigned, gentleness now suffices, and where difficulty and pain were common accompaniments, facility of reduction and painlessness are now the rule. Their use has superseded the old treatment by venesection, tartar emetic, the string of students, and the pulleys. Under their influence, all muscular spasm ceases to be a force which has to be overcome, and the surgeon has simply to replace the bone through the rent in its capsule, by such gentle manipulative acts as the special requirements of each case appear to indicate. The facility, however, with which a dislocation is reduced by manipulation, turns much upon a surgeon's knowledge of the way the dislocation was produced, for, in a general sense, the best way to reduce a dislocation is to make the head of the bone retrace the course it followed after it had first burst through its capsule, as the untorn parts in the capsule is doubtless the main obstacle to reduction, muscular spasm being eliminated by the use of an anæsthetic.

In neglected cases of dislocation where false joints exist and force is called for to break them down, pulleys may occasionally be wanted, but they must always be employed with the greatest caution, and under a healthy fear, for not only may the axillary artery be torn and ligaments lacerated, but worse injuries may ensue; thus, in Paris, in 1864, the forearm of a woman, æt. 64, was torn off at the elbow-joint in the attempt to reduce a dislocation in the humerus, and in London, more recently, the same dreadful accident is reported to have taken place.

After the reduction of a dislocation, the limb should be kept at rest, and fixed by bandages sometimes on a splint, and Sedillot's rule of "simply placing the joint in a position the opposite of that in which it was when the dislocation occurred" is sound. When any signs of inflammation show themselves, cold, in the shape of ice in a bag, should be employed; leeches are seldom called for.

Three or four weeks are at least required for repair to take place before any useful free movement of the joint can be allowed, although when no inflammatory symptoms appear, passive movement may be permitted at the end of two weeks; but, in dislocation of the hip, no walking or standing should be permitted for a month.

When reduction cannot be accomplished after a reasonable attempt, a second one may be made at a subsequent period after the effects of the first have passed, that is, if any sound hope exists of success being secured; some modification of the means employed probably suggesting themselves to the surgeon, upon reflecting as to the peculiarity of the case and the cause of his failure.

When the patient is an adult the difficulties and prospects of the case should be laid before him and his opinion taken; not, however, as to the desirability or the reverse of the attempt, for such an opinion belongs to the surgeon and his colleagues only, but as to the risks that must be run, for in many cases failure of reduction, more particularly of forcible reduction, is followed by some destruction of the new joint that nature has partially formed, by some inflammatory change that may end in the destruction of the joint, or in rendering its usefulness still less promising.

With respect to the propriety of attempting the reduction of an old dislocation, no definite rules can be laid down, and since anæsthetics have been introduced, those originally given by Sir A. Cooper and generally followed, require modification. Sir A. Cooper gave three months as a limit to the attempt in the shoulder, and eight weeks in the hip; yet Sedillot reduced a dislocation of the shoulder more than a year after its receipt, Brodhurst on the 175th day, Smith (U. S.) at the seventh and tenth month; whilst Breschet reduced a dislocated hip on the seventy-eighth day, Travers and my colleague Mr. Durham at the fifth month, Blackman (of Cirencester) at the sixth month. Yet such cases must be rare. Ball-and-socket joints are also more readily replaced than others. The best guides the surgeon possesses for his decision are found in the amount or absence of repair that is present in the dislocated joint. When the movement is good, there is small reason for making the attempt; for, writes Fergusson, "after three months the use of the limb is not, when reduced, greater than that which it would have acquired in its dislocated state."

When the movements are very limited, a cautious attempt to reduce the dislocation is hardly likely to be followed by a bad result, at whatever period it is made; but, as previously stated, the patient and surgeon should take counsel together on the point and share responsibility.

To facilitate the reduction of an old dislocation, it is needless to say, some anæsthetic should be employed, and all adhesions broken down by free rotation or forcible movements of the joint. When this has been effected, the head of the bone ought to be replaced by manipulation, or by slight extension, forcible extension being inadmissible. When tendons are very rigid and forbid movement, they should be divided subcutaneously, but this should be done some days before reduction is fully attempted.

Compound dislocation is one of the most serious accidents that can befall a limb, and in the larger joints is generally complicated with fracture or torn arteries. In the knee-joint the popliteal artery is generally lacerated, and, under such circumstances, amputation is the only resource. In the ankle-joint, where the accident is most commonly seen, the case should be treated as one of fracture and wounded joint by immovable splints after its reduction, and the persistent application of cold, either by means of ice or irrigation. In exceptional cases only, when the soft parts are much injured, and in very feeble subjects, ought amputation to be thought of; excision of the articular surface being always a point for consideration. In the elbow where movement is of essential importance, excision had better be performed when the wound is large, although recovery with movement of the joint may take place without it in young adults. Under all circumstances, the dislocation ought to be reduced, the question of excision or amputation turning upon the amount of mischief the soft parts or bones have sustained.

Compound dislocations and compound fractures into joints are clinically of very similar import.

When *dislocation and fracture coexist*, difficulties are often met with, but the reduction of the dislocation is often possible by manipulation aided by chloroform, where, without, it is impossible; and I have reduced with its aid in one case the head of a fractured humerus from the subglenoid position; and in another a forearm displaced backward with fractured arm-bone, and afterwards in each case adjusted the fracture with facility; I have likewise seen the head of the femur displaced upon the pubes pressed back into its socket, notwithstanding that a fracture of the shaft existed. I believe that in the majority of these cases the dislocation may be successfully treated before the fracture, the fractured bone being at the same time moderately extended. It may be prudent in some to apply splints before attempting the reduction of the dislocation, but such a step is not always necessary or indeed advisable, for with the limb encased in splints the surgeon has less influence upon the dislocated bone. When the dislocation cannot be reduced, the fracture must be dealt with in the ordinary manner. In a case I recently had under care, of a woman, æt. 66, in which the head of the femur was dislocated into the sciatic notch and an impacted fracture of the neck of the thigh-bone coexisted, a good limb was secured.

DISLOCATIONS OF THE UPPER EXTREMITY.

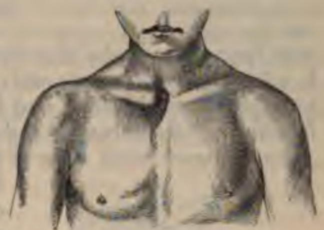
Dislocations of the spine and lower jaw have been considered in former chapters (pages 201 and 396). Those of the upper extremity will now occupy our attention.

Dislocations of the Clavicle.

Dislocations of this bone **at its sternal end** are rare accidents, though according to Flower they form about 3 per cent. of all dislocations of the upper extremity. They are produced by violence applied to the shoulder, when the scapula is fixed, the clavicle being forcibly thrown towards the mesial line. Dislocation *downwards* is an impossibility, the cartilage of the first rib preventing; but it may take place *forwards*, *upwards*, or *backwards*, and may be partial or complete.

Dislocation forwards is usually caused by some violent pressure of the shoulder backwards, although Melier (Archives Gén. de Méd.,' tom. xix) records a case in a child where it was produced by simply pulling the arm. The head of the bone in this accident forms a marked feature, and cannot be mistaken for anything else (Fig. 435). When the dislocation is *partial*, some unusual prominence of the end of the bone on comparing it with its fellow will suggest its nature, the bone being only covered with skin and readily pressed back. When *complete*, the nature of the accident will be still better marked; and the end of the bone will be usually found pointing downwards. Inflammatory thickening of the joint should not be mistaken for partial displacement.

FIG. 435.



Dislocation of sternal end of clavicle forwards. Drawing 27^{21}, Guy's Mus.

TREATMENT.—There is usually little or no difficulty in reducing this form of dislocation, by forcibly drawing back the shoulder and applying pressure to the displaced bone; though there is great difficulty in keeping the bone in its normal position; indeed, as a rule, it is quite impossible to do this satisfactorily. A pad in the axilla, with a figure-of-8 bandage to keep the shoulder outwards, the elbow being bound to the side, will do much towards the desired end; and a pad of lint applied outside the displaced end of the clavicle, and firmly fixed in position by strapping carried over the shoulder and scapula has a very beneficial tendency. Nélaton advised the use of a common hernia truss. The surgeon, however, must expect a certain amount of failure in the treatment of these cases, though he may safely assure his patient that the usefulness of the arm will be but little, if at all, impaired. I have had one case of this dislocation combined with fracture of the sternal end of the bone, in which no harm followed its non-reduction.

Dislocation upwards is very rare. Malgaigne has recorded four such cases, Hamilton another, described by Dr. Rochester, of Buffalo, and Dr. R. W. Smith a sixth ('Dublin Journal of Medical Science,' 1872). In 1865, such a case came under my care. It was in a young woman, a milliner, æt. 20, who two years before was violently crushed in a crowd, the violence causing pain which was referred to the upper part of her chest. She was treated at home and got well, although with a deformity, for which she consulted me. On examining her chest, both clavicles were resting upon the border of the sternum, behind the sternal tendons of the sterno-mastoid muscles, and, with the slightest pressure upon the shoulders, the two ends could be made to meet. By drawing the shoulders backwards, the bones could be separated and pressed back into what appeared to be their normal position, but no appliance could keep them here. The patient had good movement in her arms, and followed her occupation. I have the notes also of a second case that came under my care in 1863, in a man, æt. 35, produced by a fall on the shoulder.

In the Guy's Museum (1292^{90}) there is a specimen of dislocation of the clavicle at its sternal ends upwards and forwards.

TREATMENT.—In the treatment of this as of the last form of dislocation, there is no difficulty in reducing it by drawing outwards the shoulders and applying pressure upon the bone, but there is much in keeping the bone in position. The best means, however, are the application of a pad over the bone, the firm pressure of the scapula against the ribs by means of broad bands of strapping, and the supine position. Under all circumstances, the surgeon may comfort the patient by the assurance, that good and useful movement of the arm will be secured. *Overhand* movements, however, will always be difficult.

Dislocation backwards stands next in point of rarity to that of dislocation upwards, and is usually caused by violence, forcing the shoulder forwards, or by direct force. I have seen but one such case, in a man, æt. 52, who was crushed by falling bricks, and in it the dislocation was self-reduced on the second day, when the man was in bed. The displaced clavicle presses at times upon the trachea and œsophagus, so as to interfere with respiration and deglutition. In 1845, a sailor, æt. 17, was admitted into Guy's with such an injury, the dislocation having been caused by a blow on the shoulder. It was easily reduced by drawing the shoulders back, and maintained *in sitû* without difficulty. Cases of this kind have been recorded by Mr. Brown, of Callington ('Med. Gaz.,' 1845), and M. Pellieux, 1834 ('Revue Médicale'). In one singular case recorded by Sir A. Cooper, the dislocation was produced by curvature of the spine, and Mr. Davie, of Bungay, excised the sternal end of the displaced bone to prevent death from suffocation. Mr. C. De Morgan has recorded a case in 'Holmes's System,' vol. ii, p. 805, in which, in a girl, æt.

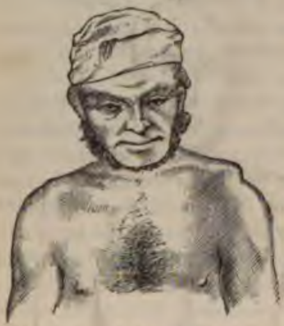
10, the bone was thus displaced and successfully treated by means of a splint across the shoulder, with a pad between it and the spine, the shoulders being drawn to the splint by a bandage and the child kept in bed. The splint was removed at the end of a fortnight, and the articulation in four weeks became as firm as that on the other side; the arm, moreover, could be moved without causing any pain.

Dislocation of the Scapula

was formerly called dislocation of the acromial end of the clavicle; but as the clavicle is a fixed point, it seems only consistent with common sense, although not with custom, to follow Skey, Maclise, and Flower, and call what have hitherto been described as *dislocations of the acromial end of the clavicle*, dislocations of the scapula.

In the more usual form of this accident, the acromion process of the scapula is forced *beneath* the clavicle. In rare cases, it may be received *above* it. Both are commonly caused by direct violence to the shoulder.

Fig. 436.



Dislocation of the scapula downwards. Mr. Poland's case.

The *symptoms* are well marked in both forms; the falling of the shoulder and projection upwards of the acromial end of the clavicle in one (Fig. 436), and the projection upwards of the acromion process of the scapula in the other, prevent any mistake being made.

Treatment.—In the dislocation of the scapula downwards, the aim of the surgeon is to raise the scapula with the arm and depress the clavicle, which is best done by drawing the elbow well backwards, and applying a pad over the clavicle; the pad and elbow being fixed in position by means of a belt or bandage passed over the clavicle and round the elbow. The belt presses the clavicle downwards, and raises the shoulder and arm upwards.

The parts fall into position at times when the patient assumes the horizontal posture, and when this is the case, and the position can be maintained for two or three weeks, it is well to adopt it. At others a pad fixed over the clavicle by means of strapping, or a bandage passed between the axilla will suffice; but the surgeon recognizing the special wants of the case, must adapt his means to meet them in the best possible way. Good movements of the arm are, as a rule, acquired in time after either of these accidents.

Dislocations of the Humerus

form at least half of all dislocations, and a sufficient explanation of this fact is to be found in the globular form of the head of the humerus, the shallowness of the glenoid cavity, the free movement of the articulation, and its liability to direct and indirect injury.

In 40 out of 60 consecutive cases, or in two-thirds of them, I found a direct blow upon the shoulder was the cause of the accident, while in the exceptional cases, a fall upon the extended arm or elbow, or a forcible dragging backwards of the arm, was the assigned cause. The accident is rare in childhood, although I have seen an instance of it at the age of 13; while Flower and Hulke have recorded a case in an infant 14 days old. Two-thirds of the cases are found in men between 50 and 70 years of age, it being comparatively rare in women and in young adult life. I have, however, treated one in a man aged 75.

Analysis of 60 consecutive cases.

Out of 60 cases, 31 were *subglenoid*, or downwards; 25 *subcoracoid*, or forwards; and 4 *subspinous*, or backwards. 49 were in males, and 11 in females.

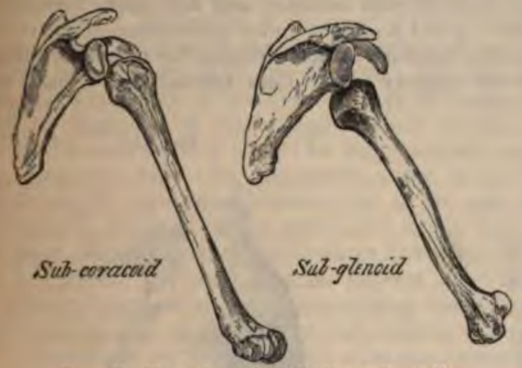
4 were in subjects under 20 years of age.
17 " " between 21 " and 50.
38 " " " 51 " " 70.
1 aged 75.

The head of the humerus may be dislocated—1. *Downwards—subglenoid.* 2. *Forwards—subcoracoid.* 3. *Backwards—subspinous.* The *subclavicular* dislocation is very rare.

When the coracoid process has been broken off, the head of the humerus may be displaced over the root of the former; two or three such cases being on record.

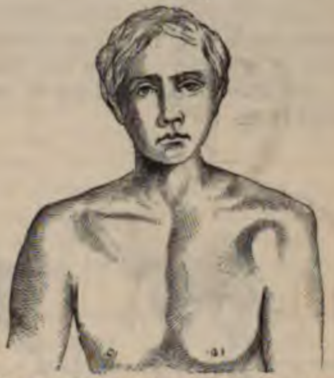
Subcoracoid.—This is probably the most common form of dislocation, but the statistics I have given place it second on the list. Flower has shown, however ('Path. Soc.,' vol. xii), that 31 out of the 41 specimens of dislocation of the shoulder-joint found in the London Museums belong to the subcoracoid class. In it the head of the humerus rests on the anterior lip of the glenoid cavity beneath the coracoid process, or even more forwards, the completeness of this dislocation turning upon the amount of laceration of the attachment of the posterior scapular muscles. When they are completely torn through at their insertion into the great tuberosity of the humerus, or the tuberosity is torn off, the head of the bone will be more forward than when they are only stretched or partially divided. Many of the cases described by Sir A. Cooper as dislocation downwards, or as partial dislocation, were doubtless of this kind; and many others recorded as examples of subclavicular, are nothing more than specimens of this variety. (Fig. 437.)

Fig. 437.



From Mr. Flower's models, Middlesex Hosp. Mus.

Fig. 438.



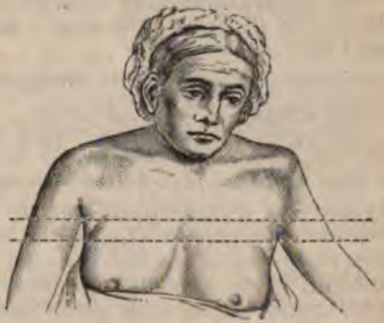
Subcoracoid Dislocation of head of humerus. Drawing 27^{48}.

Symptoms.—The symptoms of this form of dislocation in their general character are the same as in most others, such as inability to move the arm, immobility and pain often passing down some nerve trunk, and aggravated by movement. On looking at the part and comparing the injured with the sound side before swelling has appeared, some striking points will be observed, such as flattening of the deltoid, prominence of the acromion, and a depression beneath it. Extra prominence will also be seen below the coracoid process, from the head of the bone pushing forward the pectoral muscle (Fig. 438); from behind, too, there will be some flattening of the shoulder. There will be little or no lengthening of the limb, but the elbow will be found projecting more or less from the side; the movements of the forearm will be perfect. On manipulating the shoulder, the head of the bone will be felt beneath the pectoral muscle in front of the scapula, and from the elbow it will be made to move.

Dislocation downwards or subglenoid—although usually given as the most common—is probably second in frequency to the subcoracoid just described. Flower asserts that not one in ten of all dislocations of the humerus can properly be called subglenoid. In it the head of the bone rests below the glenoid fossa (Fig. 437), the rent in the capsule being at its inferior instead of its anterior border, and the soft parts mechanically interfering with the natural tendency of the deltoid, coraco-brachialis, and biceps to draw the head of the humerus upwards towards the coracoid process.

Symptoms.—The most constant pain are immobility of the arm, as well as inability to move it without pain, with a greater separation of the elbow from the side, a more marked flattening of the shoulder, greater depression beneath and extra prominence of the acronium than are met with in the subcoracoid variety. The most typical, however, are a depression of the anterior fold of the

Fig. 439.



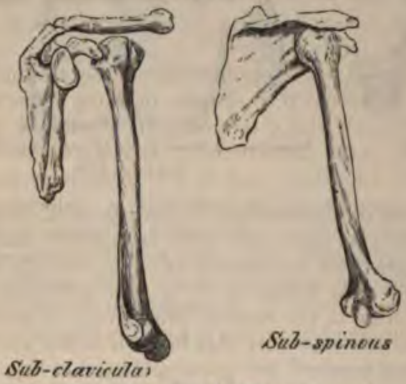
Subglenoid dislocation showing depression of the anterior fold of the axilla.

axilla from a drawing down of its attachment, the marked presence of the head of the bone in the axilla, and the separation of the coracoid process and the head of the malplaced bone by a space of one to two inches (Fig. 439).

Dislocation backwards or subspinous.—This is next in rarity to the last, and in it the head of the bone rests beneath the spine of the scapula or base of the acromion (Fig. 440); the latter position being a less complete luxation than the former, and more common. It corresponds to Malgaigne's "subacromial" variety, this completeness of the dislocation depending upon the amount of laceration of the muscles attached to the bone, and more particularly of the subscapularis.

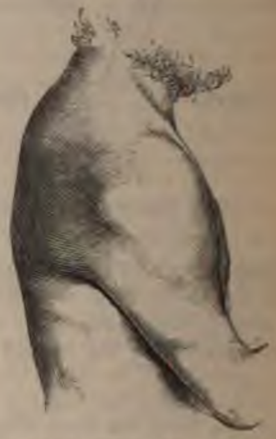
The *symptoms* of this accident are very marked. Looking at the shoulder in front there will be the flattening of the deltoid and prominence of the acromium as usual, but there will be a marked flattening if not depression of the soft parts below the coracoid and acromion processes. The elbow instead of being fixed away from the side will be drawn to it and forwards, the forearm generally pointing outwards. The back view, however, is the most typical, the head of the bone covered with muscles and soft parts forming a prominent feature in the case (Fig. 441). I had a patient under observation about thirty years of age, who could at will dislocate her shoulder in this direction by muscular action. In this dislocation the limb is said to be slightly longer than normal, but I have not found it so.

FIG. 440.



From Flower's models, Middlesex Hospital.

FIG. 441.



Subspinous dislocation of head of humerus.

Subclavicular dislocations, in which the head of the humerus rests below the clavicle on the sternal side of the coracoid process are exceedingly rare (Fig. 440). I have never seen a complete example. Malgaigne informs us that in it the arm is pressed against the chest with the elbow slightly removed from the side, the head of the bone being felt and seen in its abnormal position, and the shaft instead of the head of the humerus felt in the axilla. The bulk of cases recorded as of the subclavicular kind are probably subcoracoid.

The **supracoracoid** dislocation is a mixed form of accident, as it is secondary to a fracture of the coracoid process. Malgaigne has recorded an example, and Holmes, in the 'Med.-Chir. Trans.,' vol. xii, a second, with an account of the dissection of the case, the preparation being in St. George's Museum. He also describes a third which occurred in the practice of Mr. P. Hewett.

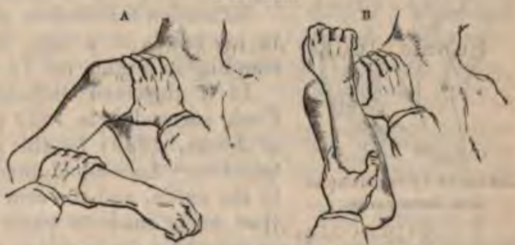
Some points in diagnosis remain to be told, and the most important was pointed out by the late Mr. T. Callaway in his excellent Jacksonian Prize Essay for 1849, which is: "*That in taking the vertical circumference of any shoulder in which dislocation exists by means of a tape carried over the acromion and under the axilla, an increase of about two inches over the sound side is an invariable concomitant.*" The same author also shows, how elongation of the limb does not take place, at any rate, to any extent; the different accounts given by authors on this point depending upon the fact, that they are content with optical rather than actual measurement. Professor Dugas, of Georgia, has also pointed out ('Southern Med. and Surg. Journ,' 1856) a sign of dislocation of the shoulder.

point that merits more notice than it has received, and I am indebted to Dr. W. Briggs, of Nashville, for calling my attention to it. It is based upon the physical fact, *that in consequence of the rotundity of the thoracic walls, it is impossible for both ends of the humerus to touch them at the same time.* "If the fingers, therefore, of the injured limb can be placed by the patient, or by the surgeon, upon the sound shoulder while the elbow touches the thorax, a condition that obtains in the normal condition of the joint, there can be no dislocation. And if this cannot be done there *must* be one, for no other injury than a dislocation can induce this physical impossibility." Dr. F. Hamilton has likewise shown ('Lond. Med. Rec.,' April, 1875) how in a dislocation, a rule will touch, at the same time, the acromion process and the elbow of the injured side, a condition that cannot exist in health.

It sometimes happens, that the head of the bone after its apparent reduction, fails to remain in position and falls out again; and when this occurs, it becomes a question whether some part of the glenoid cavity is fractured or some other fracture exists. I have recently seen a case of dislocation of the head of the humerus forwards and downwards, in which a portion of the glenoid cavity was broken off and displaced downwards, associated with severe injury to the radio-spiral nerve. In children or young persons under twenty-one, the upper epiphysis of the humerus may be separated, or rather the shaft of the humerus may be displaced off the epiphysis, which retains its normal position, and, under these circumstances, the arm should be most carefully manipulated under chloroform, to make the diagnosis sure. In exceptional cases, however, this slipping out again is not to be explained by these complications; for, in the case of a man æt. 75, who had a dislocation backwards, the head of the bone could not be kept in position till the muscles began to act after the effects of the chloroform had subsided, and I had to hold the bone in place till the patient recovered, and the muscles acted naturally.

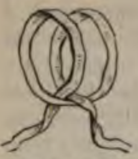
TREATMENT.—The use of anæsthetics has completely revolutionized the treatment of dislocations, and, at the present day, nothing can usually be simpler than the reduction of a dislocation of the shoulder, and what was formerly called reduction by *stratagem* is now the rule. "If you get a person off his guard," wrote Abernethy, "you have first to put your hand up to the head of the bone, depress the elbow, and it will sometimes succeed in putting it in, and the modern surgeon, in describing the reduction of dislocations by *manipulation*, might use the same language. To reduce a dislocated humerus by *manipulation*, chloroform is essential, and when the patient is *fully* under its influence as well as in the horizontal position the surgeon should grasp the shoulder with one hand, and the flexed elbow with the other (Fig. 442, A). When the dislocation is subglenoid or subcoracoid, the thumb of the surgeon may be placed over the head of the bone, and the fingers over the spine of the scapula, the thumb acting as a fulcrum; with the other hand the flexed elbow should be drawn from the side and extension made, some slight rotatory movement outwards being employed. When extension has been carried to its full extent, the elbow should then be raised and the arm made to describe a semicircle in the direction of the sternum and the face, and then suddenly brought down to the side of the thorax, the head of the humerus at the same time being rotated inwards. The thumb of the opposite hand should give the right direction to the head of the bone. (Fig. 442, B.) Should the first attempt fail, a second may succeed, or possibly a third. In the majority of dislocations of the shoulder, this method will succeed. In Philadelphia, this practice is known as H. Smith's method. In the dislocation backwards or subspinous, the same method will suffice, but in that case, the head of the bone being behind the glenoid cavity, requires pushing forwards. Under such circumstances, the surgeon should stand slightly behind the patient with one hand grasping the axilla with the thumb behind, and with the other the elbow, making extension; reduction may then be effected by drawing the elbow backwards and rotating the bone. By these means, I easily reduced an interesting case of dislocation backwards (subspinous) complicated with fracture of the ribs of the same side and of the opposite clavicle. When these means fail, or when chloroform is not at hand, reduction by means of extension with the heel in the axilla

FIG. 442.



Extension, adduction and rotation outwards.

FIG. 443.



Clove hitch.

should be employed, the surgeon with his unbooted heel pressing upon the head of the humerus or lower border of the axilla, and with his hand grasping the forearm of the misplaced limb, and making steady extension; some slight rotatory movement often facilitates reduction. The head of the bone usually slips into its place with a perceptible jerk, and the moment this is felt, all extension should be stopped.

To facilitate extension, the clove hitch (Fig. 443) may be employed; and, instead of the heel, Mr. Skey's well-padded iron knob.

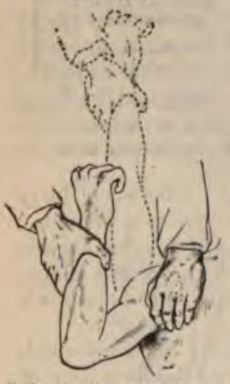
Mr. W. F. Teevan informs me that he has known the third rib to be fractured in the attempt to reduce a dislocation of the head of the humerus with the foot in the axilla.

If the humerus still resists, the following plan, writes Hulke ('Holmes's Surgery,' vol. ii, 1871), "which I have never known to fail in a recent dislocation, may be tried. The patient is seated in a high chair, which is placed about two feet from the post of an open doorway; the surgeon, having his back against the doorpost, places one foot upon the side of the chair, and with his knee presses into the axilla, and with both hands upon the shoulder, steadies the patient's body; a jack towel is then fixed by a clove-hitch knot to the patient's arm, just above the elbow, and by its means two or three assistants, placed on the other side of the doorway, make steady extension horizontally outwards."

This is only a modification of Sir A. Cooper's plan of bending the extended arm over the knee, placed in the axilla with the patient sitting, using the humerus as a lever; and is, doubtless, a good one.

Should these means fail, success may be secured by drawing the arm vertically upwards, as practised by White, of Manchester, in 1764, and recently advocated by Mr. Lowe, of Burton-on-Trent ('St. Barth. Rep.,' 1870). In 1864, I succeeded by these means in the case of a subglenoid dislocation of one month's standing, in a man æt. 64, the method of manipulation and extension having failed; and again, more recently, in a similar case of twenty-four hours' standing, in a gentleman. æt. 30, when every other means had proved unsuccessful (Fig. 444). Mr. Lowe places his patient in a sitting posture on the floor, and then stands behind him on a sofa forcibly extending the dislocated arm upwards, the scapula being kept fixed by the surgeon's foot. In all cases, the extension should be gradual and steady, the counter-extension effective; no jerking or great force should be allowed; pulleys are to be looked upon as dangerous appliances; with the use of anæsthetics they should be abandoned. In recent dislocations they are never needed; and in the old, adhesions should be broken through by forcible rotation and flexion of a joint rather than extension.

FIG. 444.



Reduction by extension of arm downwards.

Extension forwards is at times beneficial. It proved successful in my hands in a case of subspinous dislocation of three weeks' standing in a man, æt. 75.

In a neglected dislocation of twenty-five days' standing, Mr. Cock succeeded in 1859 (*vide* author 'On Diseases and Injuries of Joints,' 1859) by the following plan, all other means having failed:—"An air-pad, made of vulcanized india-rubber, was placed in the axilla, and the arm firmly bandaged to the side, the air-pad thus being made to exert a powerful outward pressure upon the head of the bone. Upon removing the bandage upon the third day, the head of the bone was found to have returned to its natural position."

Without chloroform, obstacles to the reduction of a dislocation of the shoulder are muscular spasm, and the difficulty of replacing the head of the bone through the rent in its capsular ligament. With chloroform, the resistence of the muscles is an element which has not to be considered, the second one alone existing. In old dislocations, the presence of adhesions is an extra element of difficulty.

After the reduction of a dislocation the arm should be bound to the side for a week, and kept at rest for a fortnight or more, all violent exertion being forbidden for several months, the object being to give time for the injured parts to recover their power, and ruptured muscles to unite or form fresh adhesions.

It happens at times that the trunks of the nerves are so injured as to give rise to paralysis of the muscles supplied by them. I have seen, in one case, the parts supplied by the ulnar nerve permanently paralyzed; and, in another, those supplied by the musculo-spiral. It is by no means uncommon to find the circumflex nerve so injured as to be fol-owed by a most complete wasting of the deltoid muscle. In many cases, however, in which paralysis follows dislocation, recovery may ensue, and in a very marked example I saw in 1874, in which paralysis of all the parts supplied by the radio-spiral nerve was most complete, recovery took place in fifteen months.

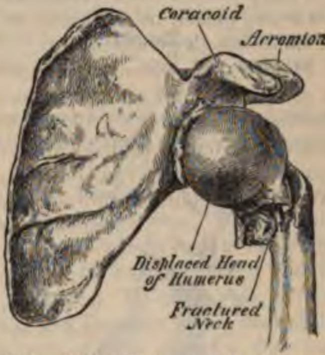
The axillary artery may likewise be lacerated. Callender ('St. Barth. Rep.,' 1866) has recorded such a case; and Dr. R. Adams ('Cyclo. Anat. and Phys.,' art. "Shoulder," p. 416) another.

In neglected dislocation of the shoulder it is always a difficult question to decide as to the expediency of attempting reduction. Sir A. Cooper used to say, that after twelve weeks' rest, an attempt should not be made, and, in a certain sense, such an opinion is correct; but there are many cases of less standing in which the attempt would be wrong, and some few of much longer standing, in which it would be right.

Where good movement exists after twelve weeks, there is little need for the attempt, unless under exceptional conditions. When bad movement exists, or none at all, the attempt may be made, for cases are on record in which reduction has been effected after a year or more.

Fracture and dislocation of the head of the humerus occasionally occur together, and, when the dislocation can be reduced at once, as it may by means of chloroform, so much the better. When it cannot, the fracture must be treated and the dislocation left alone, good movement at times being the result. In Fig. 445 such a complication existed. The preparation was taken from a gentleman, æt. 64, three months after the injury before union had taken place at the seat of fracture.

FIG. 445.



Dislocation of the head of the humerus associated with fracture.
Prep. 1114³⁴, Guy's Hosp. Mus.

Compound dislocations of the shoulder are grave accidents, and, when the soft parts have been much injured, the best plan is probably to resect the head of the bone, although when the wound is limited or clean and reduction easy, it may be right to treat the case as one of wounded joint.

Dislocation of the elbow.—This accident is most common in early life, and according to the Middlesex Hospital table ('Holmes's Syst.,' vol. ii) more than half the cases occurred in boys between the ages of five and fifteen. Dr. Hamilton found 19 in children under fourteen years of age, out of 33 cases. At Guy's, these proportions are not quite so large, for out of 13 cases, 6 were in subjects between ten and twenty; 3 between twenty and thirty; 3 between thirty and forty, and one between forty and fifty. In only one case was the subject a woman.

Both bones may be displaced *backwards*, *outwards*, *inwards*, or *forwards*, backwards and outwards, or backwards and inwards. The *ulna* may be displaced backwards alone, the radius maintaining its natural position; and the head of the *radius* may be thrown forwards or backwards.

These dislocations may be more or less complete, simple or compound; uncomplicated, or complicated with fracture of one or more of the bones entering into the formation of the joint, or with displacement of an epiphysis.

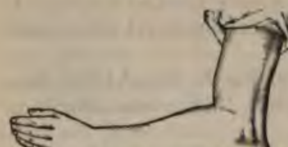
In point of frequency, dislocation of both bones backwards is the most common, the other dislocations of both bones occurring in the order above given; dislocation forwards being so rare that without a fracture, its existence was doubted by Sir A. Cooper, but Velpeau and Canton have each recorded undoubted examples.

The force required to produce any one of these injuries is severe. It is generally exerted directly upon the elbow, or indirectly upon the hand, either by a fall or twist. To admit of any dislocation, there must of necessity be much laceration of the ligaments.

Symptoms and diagnosis.—These accidents are not difficult to diagnose when they are seen at an early period of their existence, though after the lapse of some hours great difficulty may be experienced owing to the swelling masking the points of bone, and rendering it difficult to make out their relative positions.

The injured joint should always be carefully examined, each point of bone felt for, and its relative position with other points compared with those of the sound limb, although, too, in all forms of dislocation or fracture about joints, the surgeon should compare the sound with the injured side, in none can he derive greater assistance, or feel more

Fig. 446.



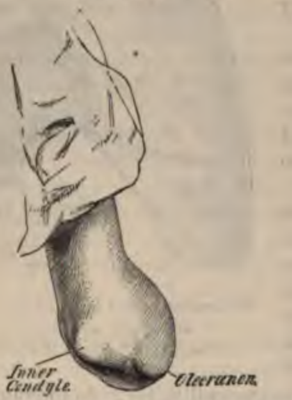
Dislocation of radius and ulna backwards. From Sir A. Cooper.

forcibly the value of the rule than in dislocations of the elbow. The student should accustom himself to the manipulation of healthy joints, and learn where to place his finger upon their different prominences and depressions; and having learned the normal conditions, he will find usually but little difficulty in discovering when a displacement has occurred.

When both bones are dislocated *backwards* (Fig. 446), the forearm is partially flexed and the hand slightly pronated; the displaced bones project backwards and make a prominent swelling with the tendon of the triceps, while the condyles of the humerus can readily be felt in front pushing the artery and soft parts forward; the inner condyle of the humerus and the olecranon being far apart; and the great increase in the antero-posterior diameter of the joint seen at a glance. In thin subjects, the olecranon and the head of the radius can readily be felt in their abnormal position, and the head of the latter bone made through the hand to rotate in its new situation.

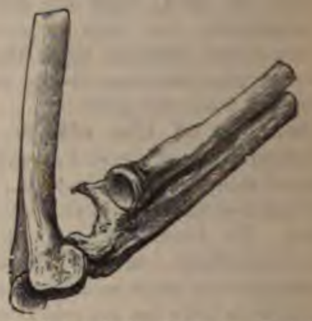
In the dislocation of the bones *outwards*, the marked prominence of the inner condyle of the humerus as seen from behind is a typical feature (Fig. 447), and, with luxation of the same bones inwards, the external condyle is prominent.

Fig. 447.



Dislocation of the right radius and ulna outwards. Posterior view.

Fig. 448.



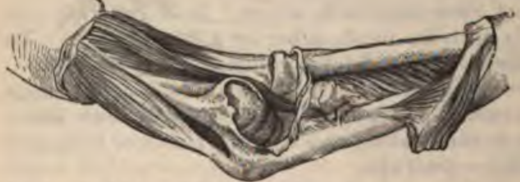
Dislocation of radius and ulna forwards. Canton's case. 'Dub. Quart.,' Aug., 1860.

In the rare form of dislocation *forwards* (Fig. 448), the loss of the olecranon from its right position, the unusual prominence of the condyles of the humerus, and the marked elongation of the forearm, are the chief features.

In dislocation of the *ulna backwards*, the pronation and twisting inwards of the hand, the great shortening of the ulnar side of the forearm, and projection backwards of the olecranon, mark the nature of the accident.

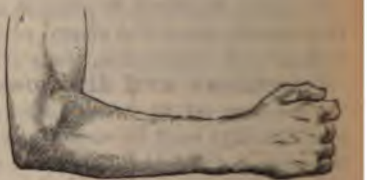
When the *head of the radius* is displaced alone forwards (Fig. 449) or backwards, its absence from its natural position, as well as its presence in an unnatural one, can usually be made out. In the forward dislocation the flexion of the joint is limited.

Fig. 449.



Dislocation of the radius forwards. Drawing 27^{40}, Guy's Hospital. From dissection. Mr. Hilton's case.

Fig. 450.



Dislocation of the head of radius backwards.

In the backward (Fig. 450), the movements may be complete; more commonly, however, they are limited.

TREATMENT.—When the nature of the dislocation has been once recognized, there is little difficulty in its treatment, for with the patient anæstheticized and the muscles consequently paralyzed, the reduction of any dislocation of the elbow by *manipulation*, or rather by moulding the joint into its right form is readily effected. This may usually be done by the surgeon's hands, pressure being applied according to the wants of the individual case, guided by the known anatomy of the part. Occasionally extension of the forearm is required, or the forcible bending of the forearm over the surgeon's knee or thumb, but in the majority of early cases the joint may be moulded into its normal position.

When some weeks have been allowed to pass without reduction, considerable force may be required to break down the adhesions, forcible flexion and extension being then applicable.

Up to two months, any dislocation of the elbow may be reduced, or rather an attempt at reduction may be made. After that date when useful movement has become possible, the attempt had better not be entertained. When no movement exists, it is, however, justifiable, but no definite rule can be laid down on this point, since each case must be judged upon its own merits. I have reduced, after nine weeks, a dislocation of the bones of the forearm backwards, with an excellent result, and have failed after five. What would be justifiable under some circumstances would be unjustifiable in others, the age of the patient, his position or occupation, and necessities, having as great an influence in guiding the surgeon as the time that has elapsed after the accident, and the amount of useful movement in the joint.

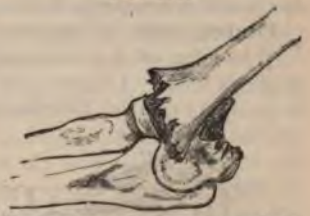
When both bones are displaced, or the ulna alone, the surgeon should grasp the forearm as a whole. When the radius is the bone displaced, the extending force should be applied from the hand.

After the reduction of the dislocation, the arm should be kept in a splint, and cold lotion or ice applied, according to the amount of inflammation that ensues. When little inflammation follows, passive movement may be allowed in about ten days or a fortnight. After the reduction of a dislocation of the head of the radius forwards, there is usually great difficulty experienced in keeping the bone in its position. To effect this, I have found the forced flexion of the forearm the best, the wrist and forearm being bound by means of a bandage to the arm. In a recent case the benefit of this practice was well displayed.

When reduction of a neglected dislocation has been effected, it is wise to fix the elbow on an angular splint for ten days or a fortnight, and to apply cold water, and, after all inflammatory action has subsided, to allow of passive or, possibly, forcible movements, as a stiff elbow joint is a misfortune of no mean importance, and to prevent it measures may be employed which, under other circumstances, might be considered rash. In neglected cases, where reduction is beyond all hope, the surgeon may use a considerable amount of force to flex the forearm to a right angle, in which position it should be fixed.

In *compound dislocation* of the elbow-joint where reduction is possible and the wound small, the case may be treated as one of wounded joint, viz., by splints and the application of ice, good hopes existing of a sound recovery being secured with movement. When the wound is large and the soft parts are materially injured, excision of the joint should be performed, the success attending this practice generally being very satisfactory. When the vessels and nerves are clearly so injured as to preclude the possibility of a useful limb being secured amputation may be required.

FIG. 451.



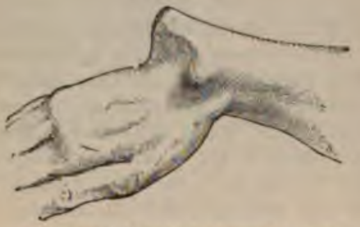
Displacement of lower epiphysis backwards. Hutchinson's case.

In all these dislocations of the elbow, the surgeon should be careful to ascertain that they are uncomplicated; that no fracture coexists; or, what is more common in young subjects, that no displacement of the lower epiphysis of the humerus is present, such as is shown in Fig. 451. This can only be made out by a careful comparison of the sound and injured sides, and the appreciation of the crepitus of fracture, the crackling of effusion, and the semi-crepitating feel of a displaced epiphysis.

Dislocations of the Wrist.

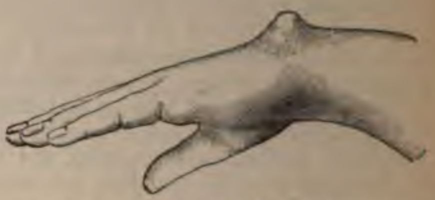
These are exceedingly rare accidents, the majority of cases recorded as being of this nature being fractures of the lower end of the radius. What is known as Colles's fracture is the more common form of accident. Dupuytren pointed this out years ago, and the truth of the observation is now fairly recognized. When dislocation does occur the hand is displaced either *forwards* or *backwards*, the ends of the radius and ulna forming prominent points in the opposite positions, and the styloid processes of the radius and ulna being recognizable points in a line with the shafts of the bones of the forearm (Fig. 452). This feature is important, for when the displacement of the hand is due to a fracture of the lower end of the radius and ulna, the styloid processes will be in connection with the hand, instead of the shafts of the bones.

Fig. 452.



Dislocation of the hands forwards. Taken from a cast of Mr. Cadge's, copied from Erichsen's work.

Fig. 453.



Dislocation of the hand and radius forwards off the ulna.

Treatment.—Reduction by manipulation is readily performed, extension of the hand and direct pressure upon displaced bones, as a rule, effecting the surgeon's purpose. The parts should be kept in position by an anterior and a posterior splint extending to the flexure of the finger. The splints should be removed, however, as soon as the parts have become firm, and passive movement of the fingers should be enforced.

Dislocation of the lower end of the radius with the hand may take place whenever the hand is forcibly pronated or supinated. When forcibly pronated, the ulna projects backwards, and the radius and hand forwards; when supinated, the reverse conditions are found to exist.

I have seen the former accident but once, and that case is figured 453. It was in a woman, æt. 56, who was admitted into my ward at Guy's for another affection. The dislocation had taken place some months previously, and had never been reduced. It was the result of a fall upon the dorsum of the hand. Pronation and supination of the hand were limited, and the ulna was fixed in its new position. The hand was more pronated than natural, but very useful.

Such dislocations are readily reduced by extending the hand and also by the application of pressure to the displaced bones. After their reduction, anterior and posterior splints should be applied for two or three weeks to prevent the bones slipping out of position, and to allow the ligaments time to unite. In the case figured no treatment was available.

Dislocation of the carpal bones is an occasional though rare accident, and the displacement of the *os magnum* backwards, from a fall upon the flexed hand, is the most frequent form. I have known this to occur in a woman during the efforts of parturition in grasping a towel and forcibly bending the wrists, the bone being pressed out of its connection. When the accident occurs, the prominent head of the bone on the dorsum of the wrist in a line with the metacarpal bone of the middle finger is too marked a feature to allow of there being any difficulty in the diagnosis. The bone, as a rule, is easily reduced by pressure, and kept in position by means of a pad. This pad must be maintained in position for many weeks after the accident, to allow time for the ligaments to consolidate.

South, in a note to his translation of Chellius, records a case in which the *pisiform bone* was displaced; while Fergusson and Erichsen describe others caused by overaction of the flexor carpi ulnaris. Erichsen also mentions a dislocation backwards of the *semilunar bone*, and in St. George's Hospital Museum there is a specimen of compound dislocation of this bone on both sides, occasioned by a fall from a height upon the hands, in which the bones were pressed out of a wound in front of the wrist.

Maisonneuve has recorded ('Mém. de la Soc. de Chir.,' tome ii) a case, in which the second row of carpal bones was displaced backwards from the first; and Erichsen another in which the metacarpal bones were displaced backwards from the carpus. These accidents are very rare.

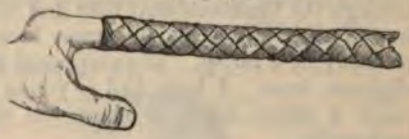
Dislocation of the thumb at any of its joints is not unusual. The *metacarpal bone* may be displaced backwards or forwards from the trapezium, the former being the more common accident. Sir A. Cooper described a dislocation inwards, but gave no case. Dr. F. Hamilton questions its occurrence.

Reduction of these dislocations by extension and local pressure is usually readily effected, the bones being kept in position by means of a pad and a good splint extending some inches above and below the displaced bone.

Dislocation of the first phalanx from the metacarpal bone is a recognized accident, the displacement *backwards* being the usual form. Dislocation *forwards* is a rare one. The first form is usually the result of a fall upon the distal end and palmar surface of the thumb, the head of the metacarpal bone projecting forwards, the base of the first phalanx backwards, and the extreme phalanx being flexed upon the first. The head of the metacarpal bone having probably been thrust forward through the capsule of the joint, and caught between the two heads of the flexor brevis muscle.

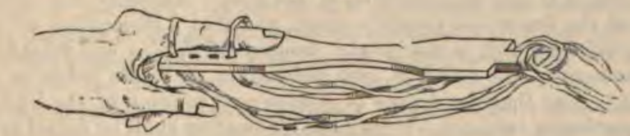
In some cases, the reduction of this form of dislocation is effected with ease by simple extension, or, by the pressure of the surgeon's thumb upon the displaced phalanx, and for the purpose of extension nothing equals in value the Indian toy called a "puzzle," or tube of plaited reed (Fig. 454). When this is not at hand, strips of strapping applied longitudinally to the distal digit and fixed by a circular piece will answer the purpose. In some instances all these means fail, and there is yet much obscurity as to the cause of the difficulty. The numerous muscles and tendons that surround the joint doubtless have a powerful influence, more particularly the two heads of the short flexor with the sesamoid bones, and, when the wound in the capsule is small, these muscles act more powerfully, the base ot the displaced bone or the head of the metacarpal bone being held by these parts "as a button is fastened into a button hole." Under these circumstances, success may at times be achieved by flexing the metacarpal bone of the thumb to an extreme degree, rotating, and then suddenly extending the displaced phalanges; this manœuvre, as it were, freeing the displaced bone from the many tendons and ligaments that surround the joint, and that doubtless, at times, interfere with its reduction. I succeeded by this method in one case where every other had failed. My friend, Mr. Sells, of Guildford, informs me that he has with facility reduced several dislocations of this form by forcibly bending the thumb back, so as to tilt the base of the phalanx over the head of the flexed metacarpal bone and then extending it. Both these means have the effect of relaxing the short flexor muscle as pointed out by Prof. Fabbri. When all such means as have been mentioned have been unsuccessfully tried, the subcutaneous division of the tendons and ligaments that appear to prevent reduction has been practised with variable success; and when this fails, excision of the part has been employed. In a case of this kind of six months' standing, when the thumb was a useless member and the seat of pain, I excised the joint with excellent success, a movable articulation being secured with hardly any deformity.

FIG. 454.



When the bone is displaced *forwards*, it seems probable from the dissections of M. L. H. Farabeuf (Arch. Gènèrales de Médicine, Sept., 1876), that the extensor tendons of the thumb stretched on the inner or outer side of the metacarpal bone is the cause of the difficulty in its reduction, and, under such circumstances, forced flexion of the thumb upon the palm aided by manipulation is generally enough to replace it.

FIG. 455.



Dislocation of the ungual phalanx of the thumb may take place in either direction, forwards or backwards, the last being the more common, and the displaced bone being so small, difficulty is often felt in applying extension to it. The puzzle (Fig. 454) is the best thing to employ for the purpose, or Levis's apparatus (Fig. 455). At times, pressure with the thumb upon the displaced bone or forcible flexion will succeed. Hamilton pithily advises "forced dorsal flexion in the case of the backward luxation, and forced palmar flexion in the case of the forward dislocation" (p. 634, ed. 3).

Dislocation of the phalanges of the fingers like those of the thumb, may occur in two directions, the backward being the more common. They are readily made out and easily reduced by extension, or flexion and then extension.

DISLOCATIONS OF THE LOWER EXTREMITIES.

Dislocations of the Hip.

These are grave accidents and are found mostly in male adults, between 15 and 45 years of age, but occasionally in the young or old. Mr. Powdrell ('Lancet,' 1868) has recorded a case in which the head of the femur was displaced into the foramen ovale at the age of six months, and reduced by manipulation. Erichsen has recorded another, of dislocation on the pubes, in a child a year and a half old. I have treated an instance of dislocation on the dorsum in a boy æt. 6, and in a girl æt. 5½; but these are exceptions. On the other hand, they may occur in the aged, since Malgaigne has recorded five between the ages of 60 and 85, and I have treated one in a man aged 73, and in another aged 66; but at this time of life fracture of the neck of the femur is more common.

The accident is always the result of violence, no slight force being required to tear through the ligaments that hold and bind the head of the femur in its deep pelvic cup; indeed were it not for the great leverage of the lower extremity, the accident would probably be a rarity. In exceptional instances, however, the bone is displaced with the slightest force. I have had a young man under my care whose femur had been dislocated a dozen times or more, the smallest twist in the limb causing its dislocation backwards.

Congenital dislocations and displacements from disease are not included in this group.

Dislocations from accident are of various forms, but the division made by Sir A. Cooper is, doubtless, practically the best, if we remember that varieties of each form or partial dislocations, are met with in practice; since there is good reason to believe that the head of the thigh-bone may rest at any point round its socket.

1. Dislocation *upwards* and *backwards*, on the dorsum ilii is the most common.
2. Dislocation *backwards*, towards the ischiatic or sciatic notch—a variety of the latter—stands third on the list as to frequency.
3. Dislocation *downwards* and inwards, into the foramen ovale stands second.
4. Dislocation *upwards* and *forwards*, upon the pubes, is about equal in frequency to that towards the sciatic notch.

These several forms of dislocation depend much upon the degree of flexion or extension, and of inward or outward rotation of the thigh at the time of luxation. The head of the femur under most if not all circumstances, as demonstrated by Mr. Henry Morris in an able paper ('Med. Chir. Trans.,' 1877), leaves the acetabulum, when the lower extremity is *ab*ducted, through a rent in the capsular ligament where it is the thinnest, viz., at the inner and lower side of the joint (Fig. 456A), the strong ilio and ischio-femoral ligaments situated on the anterior, outer and posterior aspects of the joint and the shape of the acetabulum preventing displacement in any other position. With the limb abducted, however, the head of the femur is more than half out of the acetabulum, the ligamentum teres is quite loose and all the strong portion of the capsule is relaxed. Indeed Mr. Morris believes, that it is only in *ab*duction of the lower extremity that a simple dislocation of the head of the femur can possibly occur, and that a dislocation on to the dorsum ilii or towards the sciatic notch is due to the amount of *flexion* and rotation of the limb *inwards* at the moment of the accident, and dislocation on to the pubes to *extension* and rotation *outwards*. Also that the degree of *flexion* and rotation of the limb *inwards* determines in any particular instance whether the dislocation shall be dorsal or ischiatic, the latter variety occurring when flexion is carried to an extreme.

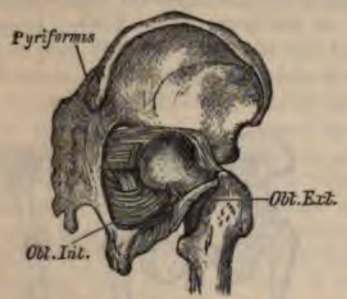
Direct dorsal dislocation can only be produced by immense violence and is often complicated with fracture of the acetabulum.

In all cases, the round ligament and capsule are torn across, the muscles about the joint being more or less lacerated.

The following analysis shows many of these points:—

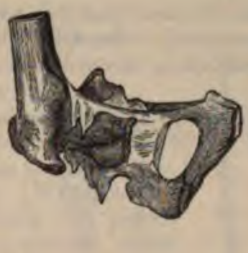
Out of 54 consecutive cases which have occurred at Guy's and in my own practice, 27 were on the dorsum, 12 into the foramen ovale, 8 into the sciatic notch, and 7 on the os pubis.

FIG. 456.



Recent case of dorsal dislocation.

FIG. 456A.



Rent in capsule, with femur flexed.

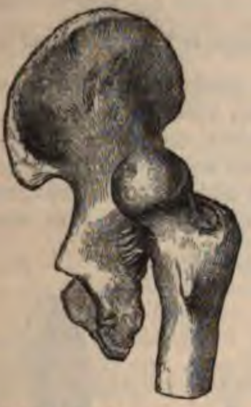
From Mr. Morris's paper.

Eleven occurred in subjects under 20 years of age, the youngest being 6; and 28 between the ages of 21 and 40; while 15 had passed that period.

Forty-six were in the male, and 8 in the female sex.

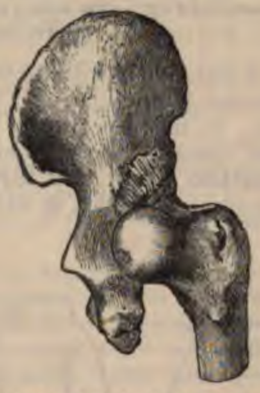
Dislocation on the dorsum ilii, or backwards and upwards, forms about half of all the cases of dislocation at this joint, and is usually produced by some twisting movement of the body or limb when the latter is abducted, or from a crushing weight received when in a stooping posture. It can be recognized by the following signs, viz., the flexed position of the thigh, the knee when the patient stands projecting in front of but above the other; the rotation inwards of the limb, the great toe resting on the instep of the opposite foot; the projection of the great trochanter and its approximation to the anterior superior process of the ilium; the elevation of the fold of the buttock; the immobility of the limb, and the pain produced by any attempt to abduct or to extend it; and the marked shortening of the limb from an inch and a half to two and a half inches (Fig. 459).

FIG. 457.



Dislocation of the head of the femur on dorsum. (Backwards and upwards.)

FIG. 458.



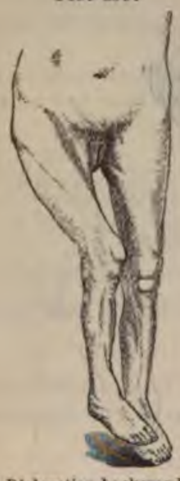
Dislocation of the head of the femur backwards.

Taken from specimens in the Middlesex Hospital Museum, and prepared by Mr. Morris.

In thin subjects, the head of the bone may be felt lying upon the dorsum ilii, and in all there will be an unnatural fulness of this part. Slight flexion and adduction will usually be borne, while patients may support the weight of the body on the injured limb, or even walk upon it.

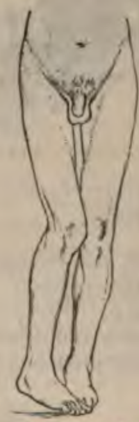
Dislocation backwards towards the ischiatic notch forms about a seventh of all cases and may be regarded as a variety of the one just described; indeed, Erichsen describes the two forms together as the ilio-sciatic. It is characterized by the same though less marked symptoms. There is less shortening, but if the patient be placed upon his back and the thigh be flexed upon the trunk at a right angle, then the knee of the dislocated limb will sink below that of the other side from one to two inches (Figs. 460*a*, 460*b*), the trochanter is drawn up and rotated forwards, but not to the same extent; and the head of the bone cannot be felt. To the eye, the limb assumes much the same position as in the last form, but there being less shortening the toes rest on the ball of the great toe of the opposite limb instead of on the instep (Fig. 460). Bigelow believes that this form of dislocation is due to the protrusion of the head of the bone below the tendon of the obturator internus muscle; whereas, in the former kind the bone is protruded above the tendon. In this, however, he is wrong, as Mr. Morris has shown that the head of the femur in *all* forms of dislocation makes its exit from the acetabulum below this tendon.

Fig. 459.



Dislocation backwards on the dorsum. Drawing 305.

Fig. 460.



Dislocation into the sciatic notch. From Bigelow.

Fig. 460*a*.

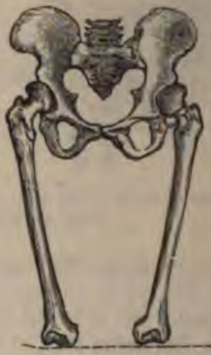


Fig. 460*a* shows position when the limbs are extended, the shortening being slight.

Fig. 460*b*.

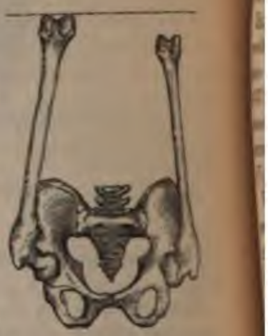
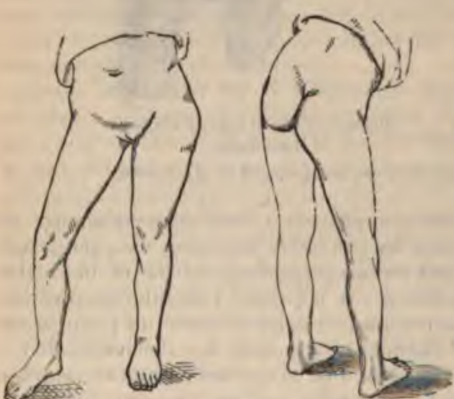


Fig. 460*b* shows the limbs raised to a right angle with the recumbent trunk, the shortening being very striking.

From paper by Dr. W. Dawson, of Ohio.

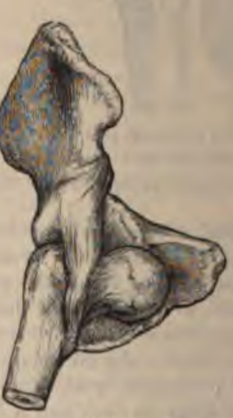
Dislocation upon the foramen ovale or obturator foramen is a very striking accident. Sédillot, as well as Boyer, believes that it is the most common of all forms, but British and American surgeons usually place it third on the list. In my own table it stands second. It is generally caused by some forced abduction of the knee or foot, the head of the bone being tilted inwards. In the case from which Fig. 461 was taken, it was caused by abduction of the knee, when the girl (æt. 14) was stepping out of an omnibus.

Fig. 461.



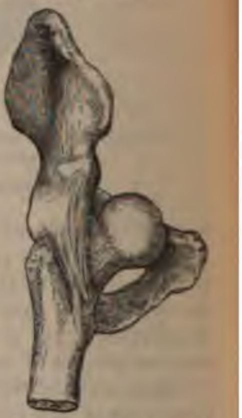
Dislocation into the foramen ovale. Taken from a girl æt. 14.

Fig. 462.



Dislocation into foramen ovale.

Fig. 463.



Dislocation upon os pubis.

From preparations.

It is characterized by the bent position of the body and the pointing of the foot forwards and slightly outwards; the approximation of the trochanter towards the mesial line and consequent flattening of the hip; hollowness below the anterior superior spinous process of the ilium; the absence of the gluteal fold, and the elongation of the limb for about two inches. Any attempt at movement causes pain. The head of the bone can often be felt in its new position beneath the adductors (Fig. 462). The patient at times can, however, walk with such an injury.

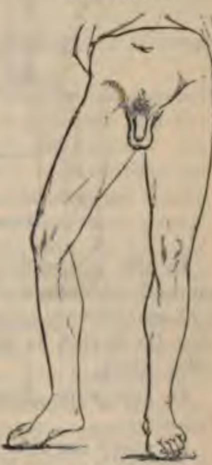
Dislocation upon the os pubis is the least common form of dislocation, and is due to forced extension and rotation outwards of the thigh, after dislocation by abduction, the pelvis being thrown forwards and the body bent backwards as the head of the femur is wrenched out of the socket and then drawn upwards.

It is marked by eversion of the limb and foot and abduction; rotation backwards of the trochanter, and consequent flattening of this region. The head of the bone can usually also be felt, if not seen, as a projection upon the os pubis (Fig. 463) or on some part of the lip of the acetabulum. When thrown above the bone beneath Poupart's ligament, it forms a very prominent projection beneath or to the outer side of the femoral artery (Fig. 464).

When the head of the bone is thrown between the anterior superior and inferior spines of the ilium, or between the inferior spine and the acetabulum, the head of the bone will be felt in that position.

Diagnosis.—With reasonable care and attention to the special symptoms which characterize the different forms of dislocation, these ought readily to be made out, although certain fractures about the neck of the femur may present others somewhat similar. I have seen two cases of impacted fracture of the neck of the thigh-bone with the foot inverted and the thigh flexed, presenting symptoms so similar to those of dislocation into the sciatic notch, that the diagnosis could not be made out till the patients were brought under the influence of chloroform, when, by gentle manipulation, the nature of the accident was discovered; the greater freedom with which the head of the bone could be made to rotate in the acetabulum, and the limp condition of the limb under chloroform in the case of fracture, forming a marked contrast to the immobility and permanent position of the thigh in dislocation. The late Mr. R. W. Smith (on 'Fracture,' 1850) records also a case of fracture of the neck of the femur which had been mistaken for dislocation.

Fig. 464.



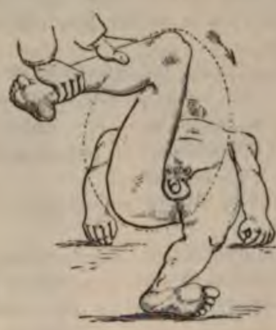
Dislocation upon os pubis. From Astley Cooper.

When in the adult the displacement recurs, after the apparent reduction of the bone and the extending force has been removed, the probabilities are, that the lip of the acetabulum has been broken off, or the head of the femur fractured (*vide* Birkett, 'Med.-Chir. Trans.,' vol. iii); and, when in a child, the displacement of the head of the bone or upper epiphysis should be suspected; it being quite impossible under both these circumstances, to maintain the bone in position, except by means of a long splint or weight to keep up extension. In all cases of a doubtful nature, chloroform should be given for purposes of diagnosis, the surgeon using the gentlest manipulation. The sudden loss of mobility, the rigidity of the limb, the absence of crepitus and other symptoms of fracture, with the positive signs of the injuries themselves, are sufficient to indicate the nature of the case. Nélaton's test for dislocation of the hip backwards is, however, excellent, and consists of a line drawn from the anterior superior spinous process of the ilium to the most prominent part of the tuberosity of the ischium. In a normal joint, the trochanter, in every position of the limb, merely touches the lower border of this line; but in all dislocations where the bone goes backward, it is found sometimes an inch above it.

TREATMENT.—Sir A. Cooper, with the surgeons of his day, considered the muscles about a joint as the chief agents in drawing a displaced bone into its abnormal position, and as forming the main obstacle to its reduction; and, as a consequence, they relied upon physical force in the form of pulleys and other complicated appliances, as the chief means by which this obstacle could be neutralized. The modern surgeon with anæsthetics in his hands knows, that the muscular system has little or nothing to do with the difficulties that are met with in the reduction of a dislocation, and that these are found in the ligaments and capsule, a large laceration in the latter allowing easy reduction, when with a small, difficulties must be experienced. With chloroform, therefore, all pulleys and mechanical appliances can be done away with—certainly in recent cases, and probably in old cases. In my own opinion they are never required, for adhesions are more readily broken down by forced flexion and rotation than by simple extension, and if these fail, no extending force will succeed. In dislocations of the hip, the reduction by flexion becomes, therefore, a reality, and is one of the greatest improvements in modern surgery.

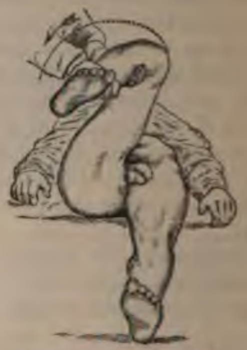
Reduction by manipulation.

Fig. 465.



In dislocation into the foramen ovale. From Bigelow.

Fig. 466.



In ilio-sciatic dislocation.

In the dislocations backwards, *ilio-sciatic*, the reduction by flexion is the correct method, adduction, circumflexion, abduction, and extension of the limb being subsequently and successively employed (Fig. 466). In dislocation into the foramen ovale the reduction by flexion is likewise good, with subsequent circumflexion inwards, and extension (Fig. 465).

In sub-pubic dislocations, the reduction by extension outwards and rotation is preferable.

To carry out this reduction by flexion and manipulation, the patient should be placed on his back on a hard couch and thoroughly anæstheticized. The surgeon should then grasp the angle of the displaced limb with one hand, and the ham with the other, flexing the leg upon the thigh, and the thigh upon the pelvis, at the same time *lifting* the limb and adducting it towards the opposite side of the umbilicus. Having effected this movement, the surgeon should, by a semicircular sweep outwards, suddenly extend the limb and bring it into a straight line with the body (Fig. 466). If one attempt fail, a second may be made, and in by far the majority of recent cases success will attend the effort. "If there is any single and best rule for reducing a recent dislocation of the hip," writes Bigelow ('Lancet,' June 15th, 1878), "it is to get the head of the femur directly below the socket by flexing the thigh at about a right angle, and then to lift or jerk it forcibly up into its place. This rule applies to all dislocations except the pubic. Flex and forcibly lift, and if this fail, flex and lift while abducting." No roughness should be used, gentle, well-directed manipulation being all that is called for, the leverage obtained through the femur being enormous. Some slight rotation of the limb outwards or inwards, according to the necessities of the case, at times facilitates reduction. Callender insists ('Lancet,' 1868), and I think wisely, upon the importance of *not fully abducting* or rolling the limb outwards, as, if this be done, the head of the bone is almost certain to roll past the acetabulum to its inner side; or, if an obturator dislocation is under treatment and the thigh rotated inwards, the head of the femur will roll round to the ischiatic notch, just reversing the movement which takes place when an ischiatic dislocation is improperly manipulated.

The object of the treatment is, to use the femur as a lever to raise the head of the bone from its backward position, and allow the stretched muscles to act naturally and draw it into place, the act of flexion completely relaxing the strong ilio-femoral ligaments. The surgeon, with his knowledge of the way in which the head of the bone was driven through its capsule, using his best endeavors to make it retrace its steps, and employing his anatomical knowledge to press, elevate, or guide the malplaced bone into its normal position. The various movements adopted in reduction by manipulation, as well shown by Morris, serve to bring the head of the displaced femur down to the notch in the acetabulum by making it retrace the course it took in the process of dislocation, and then subsequently turning it back through the rent in the capsule by a rotation the reverse of that which occurred during dislocation. This method of reducing dislocation of the hip is known in France as Deprès's method, in America as Reid's. The former employed it in 1835 (*vide* Nélaton's 'Pathol. Chirurg.,' 1847), but Dr. H. Bigelow has proved, that the credit of the method is really due to Nathan Smith, of New Hampshire (*vide* Memoirs, 1831). In a case of dislocation into the foramen ovale in a man, I failed in my first attempt by manipulation, but in the second I succeeded by the application of the slightest pressure upon the head of the bone; and in the case of the girl from whom Fig. 548 was taken the head of the bone slipped into its position by simply flexing the leg on the thigh and the thigh on the pelvis, with such gentle pressure as I was applying for a preliminary diagnosis.

In one case of severe injury to the joint that came under my care, where the bone was displaced on the dorsum, on attempting its reduction by manipulation the head of the bone slipped with such facility round the acetabulum as to illustrate every typical form of dislocation, and several intermediate or partial forms. In this case, however, reduction was subsequently readily obtained by thoroughly flexing the thigh upon the pelvis, and *lifting the* head of the femur from its false position by extension forwards.

When the rent in the capsule is small, difficulties may be felt in reducing the dislocation, but when large, little is usually experienced.

At times reduction is thought to have been accompanied when redislocation appears after the limb has been left alone; and, under these circumstances, it is probable that the head of the bone had only partially been replaced through the rent in the capsule. In other cases of this kind which refuse to remain *in sitû*, there is reason to believe that the lip of the acetabulum has been fractured, or, in young subjects, that the head of the femur has separated at the epiphysial line of junction with the neck. Still, without these explanations, cases are met with in which it is quite impossible to keep the limb in position after its reduction. In exceptional cases, the reduction of the dislocation occurs when the patient is in bed, by some simple movement. I have seen several. When reduction by flexion has failed or is inapplicable, that by extension should be employed, and in the pubic form of dislocation, no other should be used. It should be practised with the patient under the influence of an anæsthetic, and on his back, and as follows:—The pelvis should be fixed by a perineal band well padded and adjusted, and the limb extended in the line of its position to draw the head of the bone out of its bed. The surgeon should then either elevate the bone to allow the muscles to act upon it, or abduct, adduct, or rotate inwards or outwards, according to the special want of the individual case. In some cases, the simple extension of the limb with the unbooted heal of the surgeon placed firmly in the perineum will answer every purpose.

After the reduction of a dislocation, the legs should be fastened together, and no movement allowed for three weeks, and then only gentle movement, for if this rule be not attended to, redislocation may occur. In a case under my care of dislocation into the foramen ovale, in a young woman, after reduction had been effected, redislocation occurred on the tenth day, from crossing the leg over the opposite knee in attempting to cut the toe-nails of the affected limb.

Splints are hardly called for in the majority of cases, although should secondary inflammation follow or much local mischief complicate the case, they should be applied, either with ice or hot fomentations, the surgeon selecting the application that gives most relief.

Old dislocations, in a general sense, should be left alone, since in the hip, difficulties of reduction are always felt, and danger not rarely met with. During the first three weeks, reduction is rarely difficult, and may always be tried; indeed, within the month, good hopes attend the attempt. Fergusson states that after three weeks, he has never seen a successful attempt. I have seen a dislocation on the dorsum reduced on the thirty-fifth day, with an excellent effect. Success has, however, been recorded in exceptional cases up to the sixth or eighth week, or even after six months, but failure has more frequently followed the attempt. My colleague, Mr. Durham, in 1873, reduced one after the fifth month. Sir A. Cooper fixed eight weeks as the limit of time up to which the attempt should be made. When reduction has failed, good movement may often be secured after the lapse of time. The dangers attending attempts at reduction are not theoretical. Inflammation and destruction of the joint are no infrequent consequences, and fracture of the bone has been recorded by many surgeons. Dislocation of the knee or rupture of its ligaments has likewise taken place from the extension employed, and with a fatal result.

When fracture of the femur is associated with *dislocation of the bone*, the latter should, when possible, be reduced by manipulation. In 1860, I saw my colleague, Mr. Birkett, reduce with the greatest facility a dislocation of the head of the femur on the ramus of the pubis in a boy, æt. 12, when the femur was broken below the trochanter, the bone slipping into place on the application of gentle, well-directed force. Similar cases have been recorded by Bloxam and M. Etêne,

When the reduction of the dislocation by these means had failed, some hope remains that when the fracture has united, a better success may be secured. Sir A. Cooper has related an example in which reduction, by means of extension, was effected five weeks after the accident, in a youth about seventeen.

Effects of dislocation.—The sciatic nerve may be injured at times in a dislocation of the hip, and as a consequence paralysis may ensue. Morris shows in his paper how this complication is caused, while Maclise in his illustrations gives a drawing illustrating how the nerve may be stretched, and Hutchinson ('Med. Times,' 1866) a case in which the paralysis was permanent.

DISLOCATIONS OF THE PATELLA.

These are not common accidents, but when they occur are generally caused by muscular action, and at times by the application of direct force. They are most commonly met with *outwards*, occasionally *inwards*, and very rarely *edgeways*. When the ligamentum patellæ has been torn across, the patella is drawn upwards, and authors have described this accident as dislocation *upwards*.

The dislocation *outwards* is usually seen in women in whom the femora have a more oblique inward direction than in most men or in knock-kneed subjects, the bone resting on the outer condyle of the femur or on its outer edge; in the former case the outer edge of the patella tilts forwards, and in the latter inner. The knee is usually slightly flexed; it looks broader and flatter, but the unnatural position of the cap marks the nature of the accident. In 1868, I saw this accident in a male child ten months old; the patella rested on the outer side of the condyle of the femur, and was readily reduced.

Dislocation *inwards* is very rare, and easily recognized. It is always due to direct violence to the outer border of the bone.

Both these accidents are attended with laceration of the synovial capsule.

TREATMENT.—Reduction is readily effected usually by raising the heel of the limb to relax the extensor muscles of the thigh, and manipulating the displaced bone into its position, the elevation of its depressed edge being generally enough to allow the muscles to restore it to its right place. A splint should then be applied, as well as a bag of ice for a few days till all inflammatory action has subsided, the knee being strapped up subsequently for a month or more, to give time for the ligaments to unite firmly. These dislocations, however, are very prone to recur on the slightest cause, and many patients are obliged to wear for life a firm leather knee-cap to guard against such a contingency.

Dislocation of the bone *edgeways* is a very uncommon accident. I have seen only one such instance; and in it the patella appeared to show its articular facet inwards, its inner edge presenting forwards beneath the stretched skin. It was in a middle-aged woman, and produced by a direct blow upon the knee from a fall off a chair. Mayo has recorded an instance in which the bone had turned almost round.

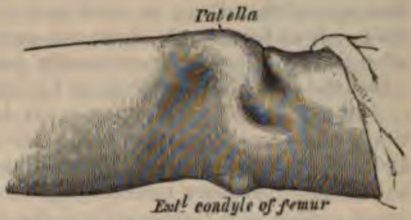
This dislocation is readily known by the peculiar aspect of the joint.

TREATMENT.—In my own case, reduction was effected with ease on raising the leg and turning the patella into its right position with the fingers. Flower only succeeded on bending the knee, after chloroform had been given. Cases have been recorded where reduction was impossible, even after the subcutaneous division of the tendon and ligament that is attached to it and other rough means, but these were employed before chloroform was introduced, which must be their excuse. Under an anæsthetic, it is probable, that by manipulation, the bone will usually be reduced, if not, it had better be left alone. Some sudden muscular effort might be of service.

DISLOCATION OF THE KNEE-JOINT.

This accident can only occur from great violence, the ligaments that bind the bones together being very strong; yet it does occur, the tibia being displaced *backwards*, *forwards*, or *laterally*. These dislocations are found in every degree of completeness. When *partial*, no complication, as a rule, exists, and the lateral is usually of this nature; when *complete*, the soft part about the joint and the fibrous tissues within, are often so injured as to render it a great question whether the joint, or even the limb, can be saved. The backward and forward dislocations are usually of this kind. When the popliteal artery or vein is injured or ruptured, amputation of the limb may be called for, this necessity being rendered more than probable when the circulation through the vessels is not speedily restored after the reduction of the dislocation, or, when a swollen condition of the limb remains. These dislocations are readily diagnosed by the peculiar deformity they display, and are easily reduced, by extension and the application of pressure, where pressure is needed. In the case from which 467 was taken, pulsation in the vessels was arrested, but it returned on the reduction of the dislocation, and recovery with complete movement of the joint was obtained.

Fig. 467.



Dislocation of the tibia and fibula forwards.

After the parts have been replaced in their normal position, splints should be adjusted and cold applied, for secondary inflammation is almost sure to follow.

Compound dislocations of the knee are generally so serious as to necessitate the removal of the joint. The attempt to save it should only be made in exceptional cases—amputation or excision may be selected.

Dislocation of the head of the fibula is occasionally met with. I have seen but three examples, one when dressing for the late Mr. Aston Key, and two since. It is generally caused by some violent adduction of the foot with abduction of the knee, the head of the fibula tearing through its ligamentous attachments and becoming displaced outwards. The accident can be readily recognized by the projection of the bone. It should be treated by the application of a pad and pressure over the part, sufficient to keep the bone in its place, the limb being flexed when necessary, to relax the biceps femoris. The pressure should be maintained for at least two months if good success is to be looked for; as a rule, the bone never quite resumes its former position, the head projecting more than usual. This deformity, however, does not appear to weaken the limb to any great extent.

Dislocation of the interarticular fibro-cartilages (semilunar) is a recognized accident. It is produced by some sudden twist of the knee with the foot everted, and generally in subjects who have relaxed joints, or such as have been the seat of some chronic synovitis. The inner cartilage seems more liable to displacement than the outer. The symptoms of the accident are well marked. A patient when walking, accidentally catches his foot against a stone, or in rising from a kneeling position is seized with a sudden, sharp, sickening pain in the knee; the joint becomes at once fixed in a semi-flexed position, and any attempt to move it excites some pain. When the first agony has subsided, a painful spot is usually left, and there the projecting cartilage may be felt or even seen, and, if the "internal derangement of the joint," as it was originally called, is left untreated, synovitis or effusion into the joint will soon show itself. When these symptoms follow such an accident as has been described, the cartilage has probably been torn from its attachment to the tibia and been doubled in or displaced.

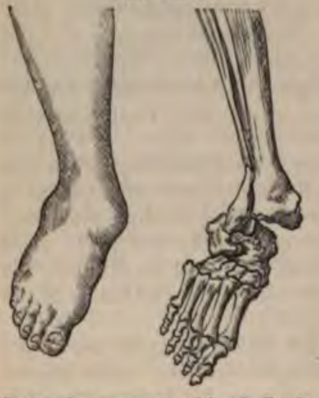
TREATMENT.—The best practice consists in the forced flexion of the joint, the slight rotation of the leg outwards, and sudden extension. When success attends this manœuvre, the joint moves smoothly and without pain, and the patient will at once be able to move the joint freely. At times, the reduction of the displaced cartilage is attended with a decided snap. After its reduction, the joint should be kept in a splint, and such means employed as the symptoms that follow indicate, for more or less inflammation often ensues, requiring ice, cold lotions, leeching, and rest. When these have also subsided it is well to restrain the movements of the joint by means of a knee-cap or strapping, as a recurrence of the accident is liable to follow upon the least occasion. I have on several occasions thought, that disease has been excited when this measure has been omitted, and I once saw anchylosis follow. Permanent lameness is by no means uncommon. When the surgeon fails to reduce the displaced cartilage, the patient at times suddenly gains relief by its self-production during some accidental movement. In other cases the cartilage reassumes its normal position more slowly. In 1873, I saw a case of this kind where this always occurred after its displacement. It was in a gentleman, æt. 30, and the inner cartilage projected beyond the head of the tibia in a most marked manner. The patient, therefore, should be kept in bed, and only allowed to move the limb, but not to stand upon it. When this result is not secured, the joint should be strapped up to restrain movement.

DISLOCATIONS OF THE ANKLE-JOINT.

Such an accident uncomplicated with fracture is rare—that is, dislocation of the foot *outwards* is generally associated with fracture of the fibula; and dislocation *inwards*, with fracture of the tibia; or both malleoli may be broken. Pure dislocations of the foot *forwards* or *backwards*, however, may occur. These dislocations are given in the order of their frequency, and are usually produced by some violent twist or bending of the foot when the patient is jumping, or by some violent impulse of the body, with the foot fixed.

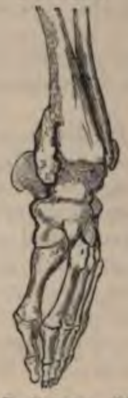
Dislocation of the foot *outwards* is better known as *Pott's* fracture (Fig. 468), the fibula being usually broken two or three inches above the external malleolus. It is caused by a violent bending of the foot outwards with the foot everted, its outer edge being raised and the inner turned downwards on the ground. At times, the extremity of the inner malleolus is broken off and displaced outwards, with the foot and astragalus. Under all circumstances, the lower end of the tibia or inner malleolus forms a prominent projection inwards, leading or misleading Sir A. Cooper and his copyists to describe this accident as dislocation of the tibia inwards. At the seat of fracture of the fibula, a depression exists. When the force is continued beyond the point necessary to cause the displacement mentioned, the lower end of the tibia may be made to project through the soft parts, and thus give rise to a *compound dislocation*. In still more severe cases, the extremities of both tibia and fibula may be made to project. the foot being completely turned outwards. Exceptional cases occur in which the foot is turned out of its socket between the malleoli, without any accompanying fracture.

FIG. 468.



External appearances of foot in Pott's fracture. Taken from Pott's work.

FIG. 469.



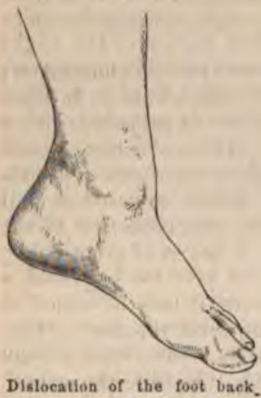
A P. Cooper. Dislocated foot inwards, with fracture of inner malleolus.

Dislocation of the foot *inwards* (Fig. 469) is the counterpart of the last-described accident, and is caused by violence that turns the foot inwards, with its outer edge to the ground. It is usually associated with an oblique fracture of the inner malleolus and displacement. The force required to produce this dislocation is very great, the tibia being a far stronger bone than the fibula, and consequently is less common. The end of the fibula is often fractured and drawn outwards with the astragalus. At times the astragalus is also fractured. The accident is known by the inversion of the foot, the sole looking inwards, and by the projection of the external malleolus, this prominent symptom having led Sir A. Cooper to describe it as dislocation of the tibia outwards.

When the force is continued or more severe, the fibula may be made to project through an external wound; and in still more severe cases, the fractured or rather exposed ends of both tibia and fibula. I have seen this more than once, and in one a sound recovery ensued, with a movable joint. It was, however, in a boy, æt. 12. I simply reduced the dislocation after washing the wound, and fixed it in splints.

Dislocation of the foot *backwards* (Fig. 467). Sir A. Cooper called this dislocation of the tibia and fibula forwards. It is usually caused by the violent propulsion of the lower end of the leg bones forwards, when the foot is fixed, and is readily recognized by the shortening of the anterior surface of the foot and the proportionate elongation of the heel, with some pointing of the toes, as well as prominence of the lower end of the tibia. At times, the fibula is fractured and the point of bone carried backwards with the astragalus. This accident is rare, it being more common to meet with fracture of both malleoli, and displacement of the foot and broken fragments backwards.

FIG. 470.



Dislocation of the foot backwards. Cast 165, Guy's Mus.

In 1862, I was called to treat a very marked case of this kind in a man, æt. 32. The astragalus with the foot seemed to have been shot completely out of its socket, and the extremities of the tibia and fibula projected so far forward as almost to rupture the soft parts covering them. The accident was caused by wrestling. The dislocation was reduced by flexing the leg on the thigh and by manipulation; but no means could be found to maintain the bones in position till the tendo Achillis was divided and the leg placed on its side and fixed on an outside splint. Mr. Cock ('Guy's Rep.,' 1855) has recorded a case of the same accident in a boy, æt. 16, where the same difficulty was experienced. He divided the tendo Achillis and bound the foot in splints and a good result was obtained.

Dislocation of the foot forwards is probably more rare than the last, and is generally only partial. It has been described as dislocation of the tibia backwards, and is known by precisely the opposite symptoms to those last described. The heel is shortened and the foot lengthened, the upper surface of the astragalus being capable of recognition by the fingers. Poland records such a case (Guy's Rep.,' 1855), in which the whole foot was much elongated and the posterior part of the astragalus caught in the anterior part of the tibula and fibula and wedged in tightly. Reduction was only effected after the division of the tendo Achillis.

TREATMENT.—The lateral displacements of the foot are not difficult of reduction by extension and well-directed manipulative force. The flexion of the knee facilitates this operation by relaxing the muscles of the calf.

To keep the bones in position, a Macintyre or flat posterior splint extending up to the popliteal space, with foot-piece and two side splints all well padded, are sufficient, as a rule, the surgeon using his judgment as to the amount of pressure and padding that may be demanded. In some cases where it is a very difficult matter to keep the parts quiet from the action of the gastrocnemii muscles, the tendo Achillis should be divided, the foot, after this simple operation, being perfectly passive, and entirely in the hands of the surgeon to place and to keep in any required position.

The limb should subsequently be slung in a proper swing, Salter's being the best. In hospital practice, two or more pieces of bandage slinging the splints to the cradle answer well. In the displacement of the foot forward or backward the same kind of treatment is applicable; but in these accidents, it is expedient, as a rule, to divide the tendo Achillis at once. This should be done at any rate when the slightest disposition to displacement is found to exist, the treatment of the case being by this operation rendered more simple and certain.

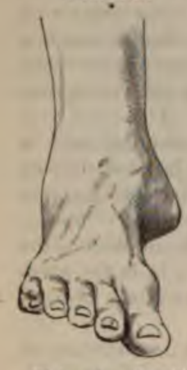
The splints should be retained for at least six weeks, and afterwards passive movement allowed. The patient should not bear any weight on the limb for another month.

The treatment of *compound dislocation of the ankle-joint* cannot be reduced to any definite rules. Each case must be treated on its own merits. In young and healthy subjects, more may be attempted in the way of saving the joint than in the old or cachectic. When a small wound exists, operative interference is only exceptionally needed; but when a large one with projection of the bones, it is a question whether the better practice lies in the reduction of the dislocation after cleansing the projecting bones, or in their resection. When the bones cannot be reduced by ordinary force, their resection becomes a necessity.

When the bones are much crushed their resection should always be undertaken; indeed, it is a general feeling in my own mind, that in compound dislocations, as in compound fractures with a large wound, it is wiser to resect the ends of the projecting bones than to reduce them. Amputation of the foot should only be performed when the soft parts and bones are much injured, and the age of the patient or his want of power forbids the hope that a recovery with a useful limb can be secured. Before any attempt at reduction is made, the parts should be thoroughly cleansed. After the reduction of the dislocation whether simple or compound, the application of ice in a bag is of great value, or the treatment by irrigation. In the suppurative stage, the latter practice is probably the better of the two. When the wound is only of a limited nature, it may be sealed at once either by lint soaked in blood, or, what is better, by the compound tincture of benzoin. Report speaks strongly in favor of washing out the joint in such cases with a weak solution of carbolic acid (1 part in 40), and then sealing the wound. Opposite the wound, an interrupted splint should be employed.

Secondary amputation may be called for in these cases, on account of gangrene or a failure in nature's efforts to effect repair, &c.

Fig. 471.



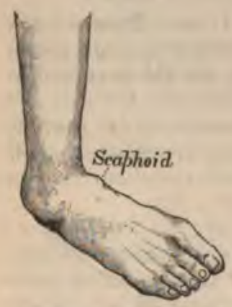
Dislocation of ankle. Astragalus between tibia and fibula. Cast 160, Guy's Mus.

Dislocation of the tibia and fibula at their lower articulation, with a forcing of the astragalus upwards between the two bones, is an accident which must be recognized (Fig. 471), and is usually produced by a jump from a height on the foot or feet. I saw a good example of it in 1869, in both feet of a man, æt. 55, who fell from a scaffold. The malleoli were widely separated and projected, the depth of the foot from the extremities of the malleoli was lessened, and the movements of the foot almost gone. No fracture could be made out. It was impossible to move the bones from the position in which they were wedged, although all means were used. Yet a good recovery took place, though with stiff joints. Sir W. Fergusson describes this accident, and gives a case.

Dislocations at the tarsal joints are met with in practice, although but rarely. They are difficult to diagnose, and still more to classify, since they are so variously described by different writers.

The first to be noticed is the *dislocation of the foot from the astragalus*, which maintains its normal position between the malleoli. The possibility of such an accident was doubted, till Mr. Pollock, in 1859 ('Med.-Chir. Trans.,' vol. xlii) published two cases. One occurred in Mr. Keate's practice in 1823. The os calcis and scaphoid with the other foot bones were displaced *outwards* off the astragalus, and, in the other which occurred in his own practice, the same bones were dislocated *inwards*. A dissection of this case is given. In the former instance the foot was everted and the head of the astragalus projected on the inner side of the instep. In the other, the foot was inverted, so that the sole turned inwards as in varus; the external malleolus was very prominent, and the astragalus projected on the other side. In some instances the surfaces of the foot are maintained in their right line. In Mr. Pollock's case, reduction was found to be impossible till the tendo Achillis had been divided, when it was readily accomplished. In an able paper, he advocates this practice whenever difficulty of reduction of the inward or outward dislocation, simple or compound, is experienced, and shows that the division of the posterior tibial tendon is occasionally called for in the outward. Mr. Turner, of Manchester, had previously advocated the same practice ('Trans. Prov. Med. and Surg. Assoc., vol. ix). An admirable paper on this subject has been published by Mr. Mac Cormac ('St. Thos. Hosp. Rep.,' 1872). The woodcut produced (Fig. 472) is taken from it, and in the case from which it was taken "the foot was violently inverted and adducted, its position being like that of talipes varus. The sole of the foot looked inwards and was nearly vertical, the outer edge of the foot, with the patient erect, would rest partially upon the ground. The great toe pointed towards the arch of the opposite foot. The inner border of the foot was somewhat shortened and more concave, while the outer was more convex than natural, and appeared as if lengthened. The outer malleolus was very prominent, while the inner could not be perceived, so deeply was it buried. Neither malleolus was fractured, and this would seem to be almost characteristic of this form of injury."

Fig. 472.



Dislocation of foot inwards off the astragalus. After W. Mac Cormac.

"The rounded head of the astragalus, completely dislodged from the scaphoid, was resting subcutaneously over the calcaneocuboid articulation. The prominence caused by the head was somewhat masked by swelling of the soft part just below it. The skin covering the head was so tensely stretched that it seemed ready to burst, and a circular slough subsequently formed at the spot. The outline of the head could, however, be easily traced, and the finger, on being passed upwards beneath the external malleolus, readily felt the cartilaginous surface of the large posterior articulating facet of the astragalus. Most of it was quite subcutaneous, and its external margin rendered the skin very tense. The interosseous ligament had been ruptured. The tuberosity of the scaphoid stood out prominently, and a depression could be felt behind it. The motions of the foot were very limited."

Macdonnell, of Dublin ('Dub. Journ.,' 1839), published a case in which the same bones were displaced *backwards*, where the heel projected, and a marked prominence existed on the dorsum of the foot, with an abrupt descent in front on the tarsus. M. Parise ('Annales de la Chirurg.,' 1845) gives an instance which is apparently unique, of dislocation *for-*

wards, in which marked elongation of the foot existed and the projection of the heel was effaced.

All these dislocations are rare. The first example of dislocation inwards that I have seen was recorded by Mr. Cock, in 'Guy's Hosp. Rep.,' for 1855, with a drawing; but in my work on the 'Joints,' 1859, I published (Case 85) an example of dislocation of the foot outwards, with a description of the dissected extremity, which had occurred in the practice of Mr. Aston Key, in 1845. The foot was amputated, reduction being impossible. The ankle-joint was perfect. The os calcis with the foot was displaced outwards. The tendon of the tibialis posticus was found in front of the tibia holding down the astragalus. The posterior tibial nerve was violently stretched over the astragalus. The limb was removed for tetanus, the symptoms immediately disappearing after the amputation. A large number of these cases are compound; and in some they are complicated with fracture of the fibula. Broca ('Mém. de la Société de Chirurg.,' tome iii), out of 13 examples of dislocation outwards, gives 9 as compound.

This dislocation may be diagnosed from displacement at the ankle-joint and dislocation of the astragalus itself by the fact, that extension and flexion are present; from fractures about the ankle, by the absence of crepitus, together with the positive signs of the injuries themselves.

TREATMENT.—Reduction should only be attempted with the patient anæstheticised, and, under such an influence, by extension and manipulation success may be looked for. When difficulties are experienced Turner and Pollock's suggestion of dividing the tendo Achillis, and even the posterior tibial tendon, or any other tendon, when it is clearly interfering with the replacement of the bones, should be followed. When these means fail and the stretched skin gives way, the case must be treated as one of a compound nature, and the astragalus excised, the foot being subsequently well confined in splints and ice applied. Occasionally amputation may be demanded, or Syme's or Pirogoff's more partial operation.

Dislocations of the astragalus alone are said to be more common than the former accidents. I have seen several such, although after reading Mac Cormac's essay I am disposed to think I have mistaken some cases of subastragaloid dislocation for dislocation of the astragalus. Pollock believes the pure dislocation of the astragalus to be very rare.

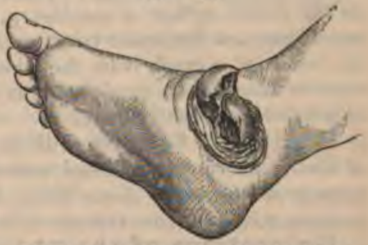
The bone may be shot out of its socket forwards, backwards, and even laterally, and, in rarer examples, rotated on its axis.

In the dislocation *forwards*, the head of the bone projects from between the malleoli; in some being shot inwards so as to forn a marked eminence beneath the internal malleolus, in others outwards. In such an accident, the heel remains in its normal position, and all movement of the ankle-joint is lost.

The dislocation *backwards*, of which Philips ('Med. Gaz.,' 1834) and Turner have cited examples, is indicated by the remarkable projection which suddenly appears above the heel, pressing out the tendo Achillis, by the shortening of the foot, and the prominence of the tibia in front.

Dislocation of the *astragalus laterally* to be complete must be compound (Fig. 470), and when incomplete at first, will probably become complete at a later period through sloughing of the soft parts. It is generally, but not always, complicated with fracture of one or other of the malleoli. Boyer has recorded a case of dislocation of the astragalus *inwards* in which no such complication existed, and in 'Guy's Reports,' for 1862, I recorded an example of dislocation of the bones *outwards* in a man, æt. 51, in which both malleoli were entire; the astragalus had been fractured and turned completely out of its bed, and was found hanging to the wound below the external malleolus. I removed the broken fragments at once, and brought the foot into a good position, a complete recovery with a stiff joint ensued. At the present time, sixteen years after the accident, the man walks about without the aid of a stick, and with no other inconvenience than that occasioned by a stiff joint, which he maintains in a very slight matter.

FIG. 473.



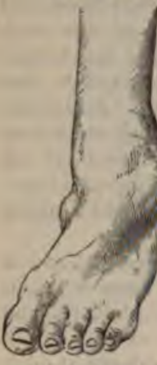
Compound dislocation of the astragalus.

Some rotation of the bone often co-exists. Fig. 474 illustrates a case of dislocation of the bone outwards, complicated with fracture of the fibula.

TREATMENT.—In simple dislocation of the astragalus when the bone can be replaced by manipulation, nothing more is needed: but such a result cannot always be secured.

When it cannot, even under chloroform, the tendo Achillis should be divided. In 1862 I was called to see a man, æt. 28, who had fallen on his feet from a height of four yards, whose right astragalus was shot forward completely out of its socket, and nearly burst through the skin. In this case chloroform had been given, and every kind of manipulation and extension employed by competent men to reduce the bone, without effect. I divided the tendo Achillis, extended the foot fully, and applied gentle pressure to the projecting astragalus, when the bone slipped back readily into its place. Some crepitus was felt, however, and, I believe a horizontal fracture of the astragalus co-existed, the upper surface and head of the bone having been displaced forwards. The foot was fixed on side splints, and a good recovery ensued with a movable joint.

Fig. 474.



Dislocation of the astragalus outwards, and fracture of the fibula. Cast 161.

When the displaced bone cannot be restored to its normal position directly after the accident, it is now fairly a settled question that it should not be removed till after the tissues have sloughed. Sir A. Cooper strongly advocated this practice, and Broca has since supported him, showing by an analysis of cases, that in 36 examples of irreducible simple luxation in which the bone was removed at once, one-fourth were fatal; while in 43 in which the bone was left alone, only 2 deaths took place, in 2 amputation was performed; in 16 the bone was removed after sloughing and all recovered; in 23 no operation was called for, recovery taking place with a useful limb.

In all compound dislocations of the astragalus, the removal of the bone should always be effected.

Dislocations of the other tarsal bones have been recorded. Malgaigne relates two cases of *dislocation of the calcis* outwards, the bone forming a projection beneath the external malleolus and beyond the cuboid articulation. In 1865, I saw a case of Mr. Birkett's at Guy's, in which the left *scaphoid bone* was displaced inwards and formed a very marked projection. It was readily reduced by pressure under chloroform, at a moment when the distal end of the foot was drawn outwards. I have the notes also of a case of dislocation of the *internal cuneiform* bone upwards with the metatarsal bone of the great toe, in a man æt. 24; of a second, in a man æt. 30, in which the same bones were displaced inwards, the accident having been produced by a weight falling on the outer ankle when the foot was resting on the great toe. In both, reduction was readily effected with a good result.

Holthouse informs us that the internal cuneiform bone may be separated from all its articulations, and thrown upwards and inwards. The three cuneiform bones are also sometimes luxated together upwards, and without much difficulty may be reduced by pressure.

The scaphoid and cuboid bones may also be displaced. Malgaigne has described this accident as a middle tarsal dislocation; Liston has described it in his 'Practical Surgery;' and Sir A. Cooper in his work 'On Dislocations.'

Dislocations of the *metatarsal bones* may likewise occur. In 1854, I saw a case recorded by Mr. Cock ('Guy's Rep.,' 1855), in which the entire metatarsus appeared to have been separated from its attachment to the cuneiform and cuboid bones and thrown on the dorsal surface of the instep, where their bases could be seen and felt. The internal cuneiform and navicular bones appeared to have been likewise injured. The injury was the result of a crush from the wheel of a railway wagon. All Mr. Cock's efforts at reduction failed, but a good foot was secured, and the man subsequently returned to his work as a laborer on the railway.

Dr. Hetzig ('Syden. Soc. Bien. Ret.,' 1865–6), who gives us an analysis of 29 cases of these tarso-metatarsal dislocations, states, that 13 were of single bones, 16 of the entire metatarsus, some of these being lateral and others vertical, as in Cock's case. In the former, greater inconvenience follows from a failure in reduction.

Dislocations of the phalanges are less common than those of the finger, and chiefly occur upwards from direct violence to the ends of the toes, and, as a rule, are compound. The great toe is the one usually injured, and, as in the thumb, considerable difficulty is at times met with in its reduction, the ligaments and many tendons around the joint affording an explanation of this fact. Such a case should be treated in the same way as dislocation of the thumb. Reduction must always be effected, when possible, by extension and well-directed pressure; forced flexion or extension sometimes facilitates the process.

CONGENITAL MALFORMATIONS (DISLOCATION) OF JOINTS.

It has been the habit of authors to describe cases included under the above heading as examples of *dislocation;* but it is clearly more correct to regard them as malformations, for as met with in the shoulder, clavicle, wrist, and lower jaw, they are always associated with a want of development in the bones, and paralysis of the muscles of the part. When seen in the hip, there is likewise good reason to believe that congenital deficiencies are also present, as the anatomical facts which bear upon the point support this view; one such is given by Cruveilhier in the second plate of the second volume of his 'Pathological Anatomy,' where an engraving of a skeleton in which this congenital displacement existed, shows it to be the result of a want of depth, from incomplete formation, of the acetabulum; and another is furnished by a valuable preparation in the Middlesex Hospital Museum (Prep. 12, series 3), in which there is practically no acetabulum, but a strong capsule and a well-developed head of the femur without a ligamentum teres.

This *congenital displacement of the hip* is by no means an uncommon affection, and is often mistaken for hip or spinal disease, more particularly when one joint alone is implicated. It generally affects both joints, occurs in female rather than male children, and in those who are in all other respects well in health and perfect in form, and although it has been boldly *asserted* that "it is beyond doubt that this dislocation is produced at birth through downward force applied to the thigh in endeavoring to hasten the birth in breech presentations," no evidence has been published to support the view. On reviewing my own experience, I must add that it does not in any way encourage such an opinion, for whilst in no case have I been able to learn that a breech birth took place, I heard in the majority that a natural birth occurred.

The symptoms of the displacement are very marked, and in its double form are well shown in the following drawings taken from life (Figs. 474, 474A), the most conspicuous being lordosis, a peculiar breadth of hips, rounding of the buttock, rotation of the whole extremity and foot inwards, and slight flexion of the thigh—in fact, the symptoms of dorsal dislocation of the hips.

Fig. 474.

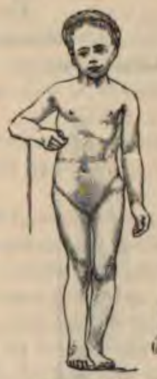
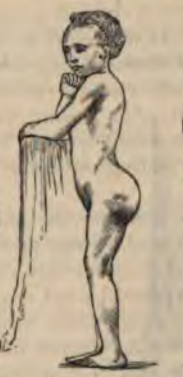


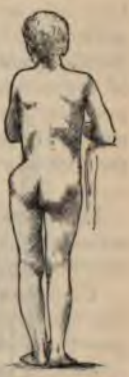
Fig. 474A.



Case of displacement of both femora.

Anterior view. Side view.

Fig. 474B.



Displacement of head of left femur.

Posterior view.

The lordosis is produced in these cases in the same way as it is in the accidental dorsal dislocation, or the acquired displacement of the head of the femur in hip disease, and can be effaced by elevation of the limb, with the patient in the horizontal position as in those cases (Figs. 542, 544).

The movements of the joint are good, at times perfect, and give rise to no pain. The head of the femur also rotates smoothly on the ilium.

When one joint only is affected (Fig. 474B), there will be shortening of the limb for about an inch, and on comparing the affected with the sound side it will be at once seen that this shortening is in the thigh, and that the trochanter is drawn up to the level of the anterior superior spine of the ilium.

The walk of a patient with a double displacement is very curious; it is a kind of "roll," not unlike that of a woman going up stairs who has some loosening of her sacro-iliac joints or very broad hips; while a patient with a single affected joint, limps and has an awkward gait, which has often led parents and others to suspect hip or spinal disease, more particularly when by over use of the malformed joint, pains are excited. Occasionally the muscles of the affected limb or limbs are weak, but this is met with in only exceptional cases.

TREATMENT.—Nothing can be recommended with the view of cure, for art cannot supply a natural deficiency or make up for a defect of structure in the bones of the joint. Still, surgery can do much towards the prevention of additional trouble by exercising the muscles of the limb and body without fatiguing them; forbidding excessive standing or walking during the years of growth, and attending to the general health.

Mechanical appliances are to be condemned as useless, if not worse. They have been employed on a wrong principle, or rather on a want of due appreciation of the conditions of parts, and therefore with only a vague hope that they may do good. These observations apply as much to the use of an extension apparatus as to operative interference, although with more force to the latter.

CHAPTER XXXI.

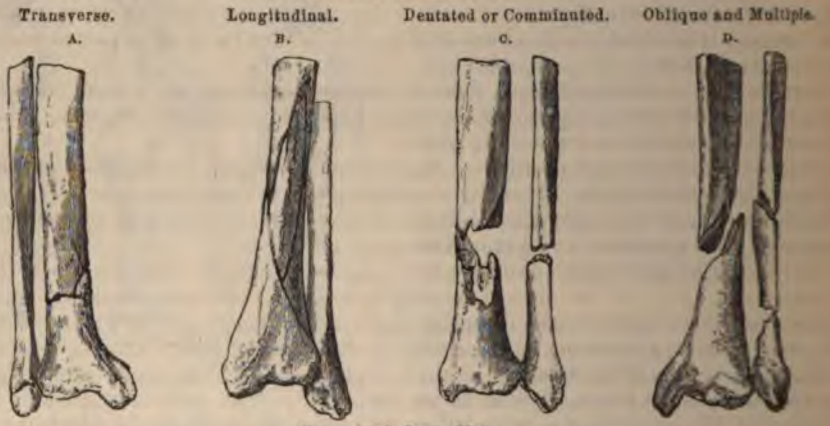
ON FRACTURES.

When a bone is broken, it is said to be fractured; when the skin and soft parts covering in the broken bone are whole, the fracture is *simple* or subcutaneous; when a wound exists *communicating with the broken bone*, whether the wound be caused directly by the same force that produced the fracture or indirectly by the bone perforating the skin, the fracture is *compound*. A simple or compound fracture is said to be *complete* when the solution of continuity is complete; *incomplete*, when the bone is only *cracked*, *fissured*, or *bent*, as in "*green-stick*" fracture, where the bone is splintered on its convex surface and not on its concave; *splintered*, when only a portion of the bone is cut off either by a sabre wound, in machinery, or by some local injury chipping off the edge of a bone; *fissured*, when the line of fracture extends partially or wholly through the bone and no separation of the fragments exist; *impacted*, when one end of the broken bone is driven into and fixed in the other. A bone may also be *perforated* by a gunshot or punctured wound.

A *complete fracture* may be transverse, oblique, longitudinal, dentate, or comminuted; multiple of the same bones, or of contiguous bones, of separate or distinct bones (*vide* Fig. 475). All fractures may likewise be complicated with other injuries, those into joints being the most important. Fractures and separations of epiphyses are also intimately connected; while fractures may occur at any age, while separation of the epiphyses is rarely found in subjects above twenty-one.

Fig. 475.

Complete Fractures.

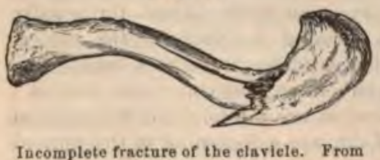


Transverse. A. Longitudinal. B. Dentated or Comminuted. C. Oblique and Multiple. D.

Prep. Guy's Hosp. Mus.

A fracture may be met with at every period of life; indeed, it may occur *in utero* from some external violence, and, when the accident has taken place some time antecedent to birth repair may have gone on to completion although in most cases with deformity, the *vis medicatrix naturæ* being, as Billroth well observes, a better physician than surgeon.

Fig. 476.

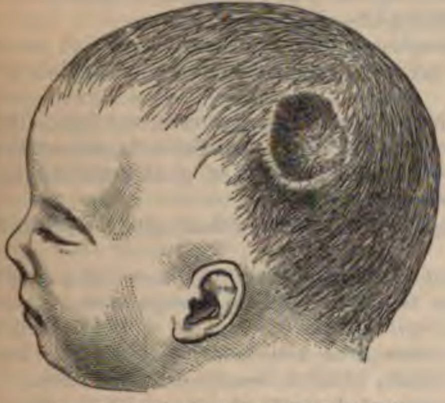


Incomplete fracture of the clavicle. From 'Holmes's System.'

I have seen this in an infant who was born with a humerus bent at right angles, evidently from a repaired intra-uterine fracture. The fractures of infancy are comparatively rare, and are commonly incomplete or "green-stick." Fig. 476 illustrates this in the clavicle, and Fig. 477 in the parietal bone. The latter was taken from a child, æt. eight months, who was thrown out of a perambulator on the pavement. No symptoms of brain disturbance followed the accident at any time. The drawing was taken on the second day following the accident. The case occurred in the practice of Mr. Harris, of South Hackney. In such cases as these, the depression in the bone may, as time passes, be gradually pressed out, but in others it is permanent.

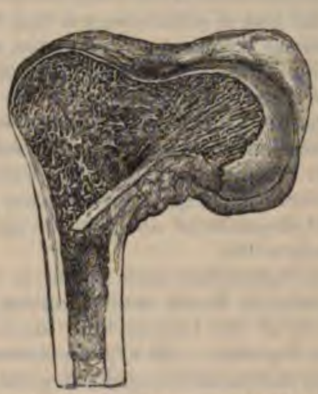
Fractures in the adult are mostly complete, though an incomplete fracture may occur. *Impacted fractures* (Fig. 478) are chiefly found in the aged, the bones at this period of life being more brittle than they are in younger subjects. They are commonly met with in the neck of the femur and the lower end of the radius, although they occur in the neck of the humerus, and other parts. Thus in Fig. 515 is illustrated an impacted fracture of the shaft of the femur.

Fig. 477.



Incomplete fracture of the parietal bone of infant.

Fig. 478.



Impacted fracture of the neck of the thigh-bone. Taken from a man, æt. 64, who recovered from the accident.

Men are more exposed to fractures than women on account of their more constant liability to injury, and those bones suffer the most exposed to external violence, hence the frequency of fracture of the lower extremities.

Diseased bones are always predisposed to fracture from slight causes, more particularly the rickety and cancerous, and those that have atrophied from any cause, or are the subject of fragilitas and mollities ossium, and likewise bones that are weakened by the presence of tumors or some syphilitic or other inflammatory affection.

In diseased or brittle bones muscular action may be enough to cause fracture. Thus, I have known a thigh to be fractured in turning in bed, in an epileptic attack, and in swinging it over the side of a cart; the humerus, in the act of hugging a wife; and in a man, æt. 26, from throwing a stone; the clavicle, from lifting a heavy weight; the ribs, in coughing; the radius, from wringing clothes; and every surgeon knows how frequently the patella and, more rarely, the olecranon are broken from muscular spasm. Mr. J. Anningson, of Burnley, has also recorded a case of a woman, æt. 42, in which the upper three-fourths of the tuberosity of the calcis was fractured, and displaced upwards by muscular action ('Brit. Med. Journ.,' Jan. 26th, 1878).

"From a review of the observations made on the bones of two insane patients," writes Dr. Ormerod ('St. Bart. Hosp. Rep.,' 1870), "it may fairly be inferred that the brittleness of the ribs depended on a morbid condition of the bones, and that this condition was general, affecting different parts of the osseous system coincidently, though more marked in the ribs than in some other more compact bones. The process was essentially one of absorption of the internal structure of the bone, the osseous tissue being replaced by an excessive deposit of the fatty matters normally existing in its interior. Thus, the usually invisible membrane lining the Haversian canals, and forming the coats of the vessels lying there, was thickened into a membrane of cognizable structure and dimensions. The space for this thickening was obtained by removal of the innermost concentric laminæ; and from this point a change was propagated which resulted in or tended to the removal of each entire Haversian system. In the whole bone there was a loosening of the mutual connection of the laminæ and an obscure disintegration of the osseous structure itself and a general infiltration of oily matter into the substance which had intruded itself within the Haversian canals, and into whatever part of the compact structure of a bone could find room for it."

In confirmation of these views I may mention, that I have been attending with Dr. Black of Canonbury, a middle-aged lady, the subject of dementia and epilepsy, who in nine or ten fits, none of them having been violent, broke a bone, and on several occasions two. The fractures took place when the patient was in bed by mere muscular action, and repaired well; indeed, as well as if the subject of them had been quite healthy.

The immediate cause of fracture is usually some *direct* violence applied to the part, or it may be *indirect*, the bone, under some bending force, giving way at its weakest point; "in the line of *extension*, not that of *compression*."—*Teevan.*

Indirect fractures are, as a rule, of the simplest kind unless complicated with joint dislocation; when compound the soft parts are mostly injured by the protrusion of the fractured bone.

Fractures the result of *direct violence*, are always the most severe, the same violence that breaks the bone injuring the soft parts over it, and often fissuring and comminuting it.

The mode of production of a fracture is consequently a point of great practical importance, both for diagnosis, prognosis, and treatment.

The diagnosis of a fracture is usually easy, though in exceptional cases it is difficult, if not impossible.

It is easy, when, after a blow or fall attended by the sensation of something giving way, *deformity* is found, with *inability to move the limb;* and on manipulation, *abnormal mobility* of the injured limb exists, with *crepitus* from the rubbing of the broken fragments together; when *pain* attends any attempt at movement, and *swelling* rapidly follows the accident; and when *shortening* exists, which is remedied by extension.

The diagnosis is difficult when, as in *impacted fractures*, abnormal mobility and crepitus are absent, and slight but fixed deformity; local pain and shortening are the only symptoms, and when the nature of the accident is the only guide. When a transverse fracture of such a bone as the tibia exists without displacement, and with no fracture of the fibula; when the fracture is into or in the neighborhood of a joint, and there is much swelling of the injured part; and when a fracture and dislocation coexist.

It is always difficult and at times impossible to make out a simple fissure of a bone, cranial or otherwise; and the same may be said of a fracture of the pelvis or thorax; such injuries as these can be made out only by the natural symptoms of fracture, as they are called, and by such as are referred to the contents of the cranial, thoracic, or pelvic cavities.

When a bone is broken near a joint, and effusion into it follows the injury, the surgeon should suspect the presence of a fissure of the bone into the articulation; and when a V-shaped fracture of the lower third of the tibia is present, the V occupying the *internal* or *subcutaneous surface* of the bone and *not* the crest (*vide* Fig. 530), this complication is to be looked for.

It is sometimes difficult to diagnose a fracture from a separated epiphysis.

When a fracture is *transverse* (Fig. 475, A), there may be no, or only some, slight lateral displacement; when *oblique* (Fig. 475, D), there will probably be some shortening of the limb from the drawing up of the lower portion of the limb, or *riding* as it is called of one end over the other. At times, there will be rotation of the limb, and in comminuted fractures separation of the ends of the bone. (Fig. 475, C). These points will be greatly determined by the character of the fracture, the bone that is involved, and the amount of muscular action that influences the fracture.

In parallel and conjoined bones of which only one is broken, the deformity that exists is likely to be less marked than where a single bone is broken; as, under these circumstances, the non-fractured bone tends to neutralize the action of the muscles through which deformity or contraction usually takes place, for muscular action is undoubtedly the main cause of deformity, tonic action of the muscles existing under all circumstances, and spasmodic action when they are irritated by fragments and attempts at reduction.

Muscular spasm being the main cause of deformity and shortening of the limb after fracture, it becomes an important point to recollect in its treatment that the peculiar deformity associated with any special form of fracture can be obviated by neutralizing the action of the muscles that produce it. Thus, in fractures of the humerus *above* the insertion of the deltoid, the action of the latter muscle will be to draw the lower fragment up and outwards, while the pectoral muscle has a direct influence in drawing in the upper fragment. In fractures of the humerus *below* the insertion of the deltoid, the tendency of this muscle will be to draw the upper fragment outward, and the brachialis anticus has an equally powerful tendency to draw the lower half forward. In fractures of the thigh-bone below the minor trochanter, the psoas and iliacus muscles naturally draw the upper fragment forwards, and rotate it outward and, in fracture of the condyles, the gastrocnemii have a powerful tendency to draw the lower end backward.

When a bone is fissured and not displaced, the periosteum not being divided, there will be little displacement, and in children this condition is often found.

Crepitus, or the grating sensation caused by the rubbing of the ends of the broken bones together, is a most valuable sign of fracture, and when detected in making the examination of a limb supposed to be fractured, the diagnosis is made clear, but, when other symptoms of fracture sufficient for a diagnosis are present, it need not be looked for. In impacted fractures, as of the hip, it can only be felt on loosening the impacted fragments, and consequently by doing irremediable harm, this error is serious, and should be avoided. In complete fractures crepitus is also absent. In fact every fracture or suspected fracture should be manipulated with the utmost gentleness, in order that as little displacement and local injury may be inflicted as possible, for the bulk of fractures can be made out with certainty without crepitus. As a symptom, however, it is always of great value.

The crepitus of effusion or of the thecæ of tendons must not be mistaken for that of a broken bone. It is a soft crepitus rather than a hard one, as in bone. Bursal crepitation is particularly liable to mislead.

When some swelling follows immediately upon the accident, it means ruptured blood-vessels, arterial or venous. When it occurs within a few hours, it is due to inflammatory effusion.

In all cases of supposed displacement, the normal condition of the limb must be inquired into, and the sound compared with the affected, for in more cases than one I have known a natural or old acquired deformity in a limb mistaken for one caused by an accident, and attempts have been made to restore, or rather to reduce it to its supposed normal condition.

Prognosis.—Simple fractures, as a rule, do well. At Guy's, in six years, out of 469 cases of simple fracture of the thigh, 17 died, or 3.5 per cent.; of 888 examples of simple fracture of the leg, 8 died, or not 1 per cent.; of 123 cases of fractured patella there was no death.

The same statistics inform us that one-tenth of all cases of fracture of the thigh are compound, and as are also one-fifth of all fractures of the leg.

Compound fractures are always serious accidents, those of the upper extremity being less fatal than those of the leg, and these less so than those of the femur. Thus, at Guy's, in six years, out of 94 cases of compound fractures of the arm and forearm, 16 or 17 per cent. died, or 1 in 6 cases; out of 202 cases of compound fracture of the leg, 56 or 27.7 per cent. died, or 1 in 4 cases; and out of 52 cases of compound fracture of the thigh, 19 or 36.5 per cent. died, or 1 in 3—the mortality increasing by 10 per cent. in each group. These statistics, however, but roughly indicate the risks of the different accidents, as they include smashes of limbs with the compound fractures.

As a cause of death after fracture of the long bones, Professor Czorny, of Freiburg, has proved in an able paper ('Berliner Klinische Wochenschrift,' Nos. 44 and 45), that "fat embolism" is to be taken into account; the fluid fat of the bones being taken up by the veins and carried to the central organs—brain, lungs, and kidneys, &c.—and thus causing death. This result, he states, is a common cause of death when a bone is much fissured and the cancellous tissue laid open as in the V-shaped fracture of the tibia, and more particularly when this is compound. He does not inform us how this accident can be avoided.

TREATMENT.—The principles of the treatment of fractures are very simple, though the practice is often very difficult. To restore a bone to its normal position, and to keep it there by means of surgical appliances, or as John Hunter expressed it in 1787, "to place the parts in a proper position by art, that is, as near their natural position as possible and keep them so," are simple rules to be observed, but to carry them out often demands the highest surgical skill and ingenuity; and yet the whole treatment of fractures is really comprised in these two indications.

In examining a fracture, the greatest care is requisite, and only sufficient manipulation should be allowed to ascertain in the *seat* of the fracture, the *line* of its direction, and the *tendency* a fragment may have to ride in any direction—this special tendency being the one point to be remembered in the treatment. These points, moreover, should be made out at the single examination prior to treatment; for repeated examinations whether by the responsible surgeon or his assistants are to be condemned, as they can only do mischief by exciting more local irritation than is necessary, and adding to the injury which the muscles and soft parts have already sustained. For this reason, when after an accident, a fracture is suspected to have taken place, the surgeon or bystanders should do no more than bind the limb to some immovable apparatus such as a wisp of straw, a bundle of sticks, or two pieces of wood fixed by a handkerchief, till the sufferer has been carried home and placed in a position in which he is to be treated. When the lower extremity is the affected part, the injured limb may be bound to the sound one, the latter acting as a splint.

In compound fracture, the same precautions are necessary. Bleeding should be arrested by the application over the wound of a pad or bandage kept in position by means of pressure and the elevation of the limb, while in more severe cases the tourniquet or some local pressure over the main artery may be called for.

If these precautions are not observed on the field, many lives are lost from hemorrhage, simple fractures are turned into compound, while compound fractures are made worse.

When a patient is placed in bed where he is to be treated, the fracture ought to be manipulated, and its *position*, *nature*, and peculiar *tendency* made out, and when made out to be "set," or put up, at once. The only exception to this rule is, when time has been allowed to pass before treatment is commenced, and much œdema or swelling of the injured extremity exists, then it is better to fix the injured limb raised upon a pillow with a long sand bag on either side to act as a splint, and possibly a third round the foot, the pillow and side sand bags being firmly bound together by a strip of bandage and the whole forming an immovable apparatus. Mr. Aston Key, indeed, was so fond of this mode of putting up fractures of the leg that in my "dresser" days it was the usual mode of treating them all through their course, that is, for the first month or five weeks, till they could be put up in some starch or other immovable apparatus, and the patient allowed to get up. The method is comfortable and satisfactory to the patient, but it wants closer attention on the part of the surgeon than can often be given.

In "setting" a fracture some care is needed, and the opposite and corresponding limb should always be before the surgeon as a guide. Inquiries should also be made as to the condition of the limb before the accident, whether it was deformed or shortened from any previous fracture or disease, congenital or otherwise, for I have known an injured leg to have been likewise violently and unnecessarily manipulated to restore a supposed fractured bone to a position that it could not be made to assume on account of some natural deformity, and likewise a fractured thigh subjected to like rough treatment to bring it down to the level of its fellow, when an irremediable shortening existed from a former fracture.

In extending a broken limb to restore the bones to their normal position, the upper portion should be firmly held by an assistant—to make *counter-extension*—and the muscles attached to it relaxed by placing the limb in a slightly flexed position; a second assistant or the surgeon may then extend the fractured end, while the latter gently manipulates the fracture to make out its points. The extension should be steady and free from all jerks and violent movement, gentle lateral, rotatory, or other movements being given as required to restore the displaced portion of bone; the pressure of the thumb or finger being freely used to bring about an accurate coaptation or settling of the fragments; for the surgeon must remember that muscular contraction is better overcome by *continued extension* than by temporary force, and that for the treatment of fractures generally, moderate extension continuously applied is preferable to forcible extension in any of its forms. The inhalation of chloroform at times is a valuable aid in the reduction of a fracture.

If, when the fractured bones have been reduced, muscular spasm is so severe as to render it impossible to keep them *in sitû*, a condition which is not uncommon in fracture of the leg, the tendon of the offending muscle may be divided. In otherwise intractable fracture of the leg, there is no operation of greater value and attended with less evil than the division of the tendo Achillis. In a general way, however, the muscular spasm ceases after the first three or four days.

When the fracture has been reduced, and by manipulation coaptated or "set," splints or other mechanical appliances are necessary to keep the bones in their normal position, and the simpler these appliances are the better, so long as they fulfil their purpose. These splints should always be well padded, and the pads so adjusted as to fit into the inequalities of the limb, and protect it from any local pressure. They should be firmly and immovably fixed to the limb by inelastic straps or bandages and the seat of fracture, as a rule, should be left exposed for the surgeon's examination, in order that the fracture may be re-adjusted if displacement take place. To cover up a broken bone by bandages or splints is a mistake. The position of the bone during the progress of repair, should be always open to view, the former practice being based on hope, the latter on certainty. Pott's rule, that the splints should include the joint above as well as below the fracture is sound, though it cannot always be followed. Every joint, however, should be fixed when by its action the broken bone is rendered movable.

When one bone is broken in a limb where double bones exist, the second acts as a splint and keeps up extension. Under these circumstances a simpler apparatus is required to keep the fractured bone quiet and restrain the action of the muscles that move it than under other circumstances.

Extension is a valuable and necessary adjunct to other treatment, and should be kept up by means of weights, pulleys, or such other appliances as the ingenuity of the surgeon may suggest. These means, however, will be described in the treatment of special fractures.

After the setting of the fracture, the essential point to be observed in its treatment is, the immobility of the broken bone; and next to this, its exposure to observation during the progress of repair to render certain that the bone has maintained its right position.

The treatment of compound fractures is similar to that of *simple*, plus that of the wound with its complications and the broken fragments or projecting portions of bone, "but *rest* of the bone is the great object we have to aim at."—John Hunter, 1787.

These fractures should be "set" in the same way as the simple, great care being observed in the manipulation that the soft parts are not more injured; loose fragments of broken bone must be taken away, projecting portions excised, and the bone reduced, the wound being enlarged when necessary to facilitate this act; the injured parts, too, ought to be thoroughly cleansed and all wounded vessels twisted or ligatured; the bones should then be fixed immovably by means of splints, interrupted splints being often required. When the wound is not very extensive, it should be sealed by means of a piece of lint saturated with blood, or, what is better, the compound tincture of benzoin. If the carbolic-acid dressing is employed, the wound should be well washed with a weak solution of one part in a hundred, and dressed under the spray. The wound should be interfered with as little as possible, since now, as when the following words were uttered: "The great mischief and bad success arising in the treatment of compound fractures is the dressing them every day and applying fresh poultices which necessarily move the ends of the bones. *The limb if possible should never be moved.*"—John Hunter, MS. Lect., 1787.

When the soft parts are much crushed, and the large vessels and nerves injured, amputation may be called for, more particularly in old subjects.

In compound fractures "scarcely any amount or form of fractured bone alone," writes Skey ('Operative Surg.'), "would justify the immediate resort to the knife if taken singly, even supposing the bone fractured extensively into a large joint; for in such a case, although anchylosis of the joint would probably occur, it would prove a lesser evil than that of amputation. Superadded to a compound or comminuted fracture of bone, the injury may be rendered yet more serious by extensive laceration of the muscles. In considering this latter condition much will depend on the kind of laceration, whether the muscles are merely cut asunder, or whether contused or torn, and whether this injury involves a few only or the majority of the muscles of the limb. Again, we must examine with great care the condition of the vessels. Is the main trunk whole? we might ask, in the supposed case of fracture of the thigh; or in that of the leg, is the posterior tibial artery torn? Is the limb colder than its fellow, or is the temperature considerably lower than the rest of the body? If so, probably one or more arteries are divided. What is the condition of the nerves? Does sensibility extend to the toes? If not, probably the nerve is divided also. If the evidence of the integrity of both artery and nerve fail, and the sinking temperature of the limb and the loss of sensibility continue to increase, we have no alternative but amputation."

If a doubt exist in the mind of the surgeon on the necessity of *immediate* amputation, he should wait, unless the patient be old, in which case let him act promptly.

Simple fractures into joints require special treatment, as in a large number of cases, although not in all, some impaired mobility of the joint will ensue; for this reason the joint itself should be placed at the most useful angle, and so fixed.

Compound fractures into joints generally demand excision or amputation. In the *upper* extremity when there is any hope of saving the limb, excision is doubtless the better operation. In the *lower*, the expectant treatment is certainly better than excision, and probably better than amputation if the parts are not so injured as to render amputation at once a necessity, and if the age and general condition of the patient justify an attempt to save the limb; but these points will again have to be considered among the special fractures. In gunshot wounds these views are now generally entertained.

The fracture bed.—The best is, without doubt, a good horsehair mattress placed on a bedstead with a firm bottom; but where this does not exist, a board beneath the mattress is a good substitute. A canvas bottom, however tightly corded, always yields, and a feather or ordinary spring bed is not to be sanctioned. The woven wire mattress is excellent.

The sheet covering the bed should be stretched and kept smooth several times daily so that no "ruck" takes place, bed-sores being more frequently caused by such than by pressure. In fracture of the lower extremity the head of the patient should not be raised too high, the use of one small pillow being ample.

Splints made of wood, iron, felt, or perforated zinc may be employed, and the different forms will be given when the special fractures are considered. As a rule, the simpler in construction they are the better; and before adapting one to the broken limb it is well to fit it to the sound. The splints should invariably be quite clean.

Pads.—All splints should be well padded and their edges carefully protected. The pads should consequently be well fitted, broad, and overlapping the sides. The best materials for these are tow or fine oakum, cotton, or sheep's wool, or, strips of thick flannel inclosed in a casing of soft linen or lint. The pads should be first fixed to the splint by tapes, or, by what is better, some pieces of strapping.

Besides wooden and iron splints, what the French called the "immovable apparatus" for fractures is a very favorite one, and the material employed may be left to the fancy or convenience of the surgeon.

In fractures of such single bones as the fibula or tibia where no displacement exists, their primary treatment by some immovable apparatus is very valuable, the limb being either put up at once before swelling has appeared, or as soon as the swelling, &c., has subsided. In other cases it is expedient to employ it for at least ten or fourteen days, until swelling has gone and a certain amount of repair taken place. In the fracture of long bones such as the femur, it it better to postpone its application till union is complete. Some excellent surgeons, and among them Erichsen, employ the immovable apparatus from the very first. The mode of its application is as follows:—In all cases the limb should be cleansed and carefully dried, the bone itself being well protected by cotton-wool or a flannel bandage. The bandage, with the stiffening material, is then to be prepared, and should be put on as smoothly as possible, no more "turns" being employed than are absolutely necessary.

Splints of gutta percha, millboard, leather, Cocking's poroplastic, or hatter's felt, or perforated zinc, may be employed as additional supports when complete immobility is demanded. The first five materials, after having been cut to pattern, should beforehand be well softened by immersion in hot water or hot air and then moulded to the limb; the zinc should be carefully cut to fit it and well adjusted. These splints should be applied over the cotton-wool or flannel bandage, and the prepared bandage then bound round. When *starch* is used (Seutin's bandage) it should be exterior, two or three coats being employed. The same may be said when the *white of egg* or *dextrine* is employed. When *gum and chalk* are used, the same mode ought to be followed, the mixture consisting of equal parts of finely powdered gum and chalk made into the consistence of thick paste by the addition of boiling water gradually stirred into it. This bandage is more solid than the starch.

Mr. De Morgan prefers the *glue bandage;* the best French glue, after having been soaked in cold water and melted in a glue pot, being applied like the starch; the addition of about one-fifth of the bulk of the solution of methylated spirit hastens the drying.

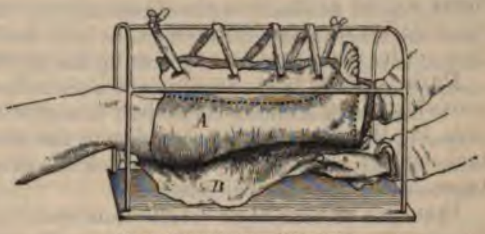
When *plaster of Paris* is employed, the bandage should be of some loose texture and that made of book muslin or crinoline is probably the best. It should be prepared beforehand by rubbing well fresh dry powder into its texture, and made ready for use by being thoroughly wetted in a bowl of water for two or three minutes; some additional plaster being rubbed with water into the bandage as it is unrolled to strengthen the whole.

When the surface is extensive the setting of the plaster may be *delayed* by the addition of a little size or stale beer to the water with which it is mixed, while salt and the use of warm water increase the *rapidity* with which the plaster sets.

The day following the application of this bandage, a coating of flour, paste, gum, or even a coating of varnish, may be applied to prevent chipping.

In the appendix to the 'Army Medical Report' for 1869, Mr. Moffitt describes the Bavarian mode of putting up a fracture in an immovable apparatus, a mode which deserves to be more widely known than it is. I have tested it well, employing gum and chalk instead of plaster of Paris, and can strongly recommend it, being simple, can be applied very quickly, and is most effective. It is now in general use at Guy's, and is applied as follows :—The materials required to make it are, a piece of stout, "coarse house-flannel," which has been shrunk, some precipitated chalk, mucilage of gum acacia, a good-sized cradle, and a stout needle and thread. When it is applied to the leg for fracture, two equal-sized pieces of the flannel are first cut, long enough to reach from the lower border of the patella to three inches below the heel, and, in breadth about six inches more than the circumference of the calf, so as to allow the edges to overlap for about three inches when the flannel is folded round the leg. One of these pieces should now be applied to the leg, its centre corresponding with the centre of the calf; and its two flaps brought tightly together over the skin (Fig. 479), where they should be firmly stitched together, the stitches being inserted close to the bone. The stitching must be begun at the upper part, carried down to the hollow of the instep, and then fastened off. Having arrived at this point, the next thing is to see that the foot is at a right angle with the leg; if left alone it will probably be at a very obtuse angle, and considerable force is sometimes necessary to bring the toes up, which must be done now or not at all. The stitching must next be begun on the sole of the foot, commencing at the toes and proceeding towards the heel, the flannel being tightly dragged downwards.

Fig. 479.



Bavarian or immovable splint.
A. First layer of flannel applied to limb. B. Second layer about to be applied.

The stitching along the sole of the foot being completed, the remaining piece along the dorsum of the foot may next be stitched, and after this there can be no fear of the foot changing its position.

The limb will now be tightly encased in a layer of flannel, the edges of which are lying in adaptation in front of the leg. The flannel along the sole of the foot to within an inch of the stitches should next be cut off and the edges turned back. At present the superfluous flannel along the front of the leg and dorsum of the foot should not be interfered with, but the limb slung up to the cradle by three or four pieces of bandage, pinned or stitched to the adapted edges of flannel in front of the leg (Fig. 479). This will have the effect of stretching the flannel and making it more closely adapt itself to the shape of the calf, ankle-joint, &c., and allow the gum and chalk to be easily applied. The next thing is, to make a thick paste of the gum and chalk the consistence of honey by stirring them together in a basin, which should be spread thickly over the surface of the flannel with a brush, or rubbed in with the palm of the hand, care being taken that it enter all the little inequalities of the flannel. Having done this, apply the outer layer of flannel, placing it just as the first was placed, with its centre corresponding with the median line of the calf, folding its edges closely around the leg, and bringing them up together in front over the edges of the previous layer. Keep them also in position in front by about half a dozen stitches put through at intervals down the leg close to the shin. Along the sole of the foot this layer of flannel may at once be neatly finished off by turning in the edges and joining by stitches. The whole should now be left suspended to the cradle for about twenty-four hours to dry, at the end of which time it may be taken down, and the splint removed from the leg by cutting up the stitches along the front of the leg and dorsum of the foot with a pair of scissors, aided by forcibly separating the adjacent edges of flannel.

It now only remains to trim up the splint by cutting off the superfluous edges, binding them with strips of leather made adhesive by being spread with resin plaster, and inserting eyelet-holes at equal distances all down, so as to lace the splint up the front (Fig. 479 A).

If the splint is required for a *knee-joint*, some modifications of the above plan is necessary. It will not do to suspend the limb to a cradle by the edges of the flannel as in the previous case, but the patient should be seated in a chair before a fire, with the heel resting on another chair. Then the first layer of flannel should be tightly applied, its edges being brought up together in front, and stitches inserted close to the leg. The gum-and-chalk paste may now be thickly spread over the surface of this flannel and covered in by a second layer of flannel exactly as in the previous case. This second layer may be fastened in front by a few stitches, and the whole allowed to dry. When quite dry the adjacent edges of flannel may be forcibly separated and the stitches divided with scissors. Lastly, the superfluous edges may be cut off, two semilunar pieces cut out for the patella, the margins bound with leather and eyelet-holes inserted for lacing up in front. To apply the splint to the *hip-joint*, it is necessary that the first layer of flannel should surround the pelvis as high as the crests of the ilium, and also the affected thigh. It should then be stitched along the outer side in one continuous seam and the superfluous edges allowed to remain in apposition. The gum-and-chalk paste must then be applied, some difficulty being probably experienced in applying it over the sacrum, but the patient must be rolled first to one side and then to the other. While this is being done the second layer of flannel should be lying underneath, so as to protect the bed, which may then be adapted and fastened closely by a few stitches, along the line of the previous sutures. When the whole is dry, it may or may not be found necessary to rip it up and insert eyelet-holes. If the splint fit closely without causing any undue pressure, the edges may be cut off close, and the whole allowed to remain as it is, but for the sake of cleanliness, especially in children, it is generally better to cut up the stitches along the outer side, bind the edges with leather and lace it up, so as to allow the splint to be removed as often as requisite.

When extra stiffness is required in any of these splints, the inner surface of the second layer of flannel may be covered with the chalk paste before it is applied, some strips of tin, or a piece of gutta-percha which has been moulded to the part, should be introduced between the two layers of flannel.[1]

In cases of compound fracture, an opening suitable to the wound may easily be made. This splint is as good for joint cases as for those of fracture, indeed it is by far the best immovable apparatus we possess.

Mr. Hyde, of Mortimer Street, has introduced a "leather-felt splint" of great value, which is readily applied, is light and strong, and rarely requires to be used with starch. Cocking's poroplastic splint answers the same purpose, the splint becoming soft on immersion in hot air or water, and hard again within a few minutes of its removal. If, when moulded, it fails to fit exactly, it can be softened locally by the application of a hot-water sponge.

Mr. L. Tait ('Med. Times,' 1865) has suggested the use of paraffin for the same purpose, the melted paraffin being kept liquid by the immersion of the bowl containing it in hot water, the bandage as it is being applied, being made to pass through the liquid paraffin melting at 105° to 120° F. Two or more coats of paraffin may be painted over the whole.

The liquid glass, *silicate of potash*, may also be used, the solution being painted over the bandage with a brush. I have used it and like it, but not so much as the splint I have described.

By way of caution it should be stated that all starch, chalk, and plaster-of-Paris splints contract on drying, and from such contractions I have known harm, and even gangrene to follow. To guard against this contingency when bandages are used, cotton-wool should be applied freely around the limb; although in the Bavarian splint this precaution is not called for.

On this account, the practice of using these splints, as a primary application in the treatment of fractures is dangerous; for when swelling to any extent takes place, the pressure may be most harmful.

When pain or swelling of the limb follows the application of any of these splints, they should be at once removed, the whole being cut up with strong scissors from end to end, eyelets being subsequently introduced for laces to draw them together again, or, straps and buckles may be employed.

Repair of fractures.—In children broken bones repair rapidly, four weeks being ample time for the whole process to be perfected, while in the aged, ten weeks or more may be needed. Repair goes on more rapidly when the broken ends of the bones are placed and kept in position than when they are apart or not kept at perfect rest. When bones are maintained accurately in position or are impacted, direct union ensues as in the soft parts, but when movement is allowed, reparative material is poured out around the broken fragments, and the provisional callus of authors, or the ensheathing callus of Paget, is formed, which, acting as a temporary splint, keeps the bones in position till they unite by means of the permanent callus. The best repair of a fracture is the direct, and when provisional callus exists some mobility of the broken bone has been allowed, to a certainty. This addition to our knowledge is due to Sir J. Paget, for until his day, a provisional callus was always looked upon as a necessary means for the repair of every fracture. We now know it is only present when mobility of the fragments interferes with direct repair, and, in proportion to the amount of provisional callus, may the extent of mobility be estimated.

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[1] I am indebted to a valued pupil, Mr. W. H. Harsant, for the above description of the splint.

When a bone is broken, blood is effused, the amount depending upon the degree of injury to the soft parts and the amount of comminution of the bone; it is exceptional to find blood between the broken bones. In simple fracture the periosteum may be only torn across; in the comminuted it is more extensively injured, while in incomplete fractures it is probably always entire.

After a simple fracture some slight inflammatory exudation may be poured out around the broken bone, which in healthy subjects is very limited and unattended by any constitutional symptoms. In more complicated cases or in cachectic subjects, the effusion may be extensive, and constitutional symptoms with febrile disturbance severe. Under favorable conditions, this inflammatory material will be absorbed with the effused blood. The true reparative material is poured out about the sixth or ninth day, and, when no displacement exists, it will be effused only between the ends of the broken bones; when, however, the bones are comminuted it will be more diffused. When they are misplaced, it will be still less defined, and when the periosteum is much separated or torn, it will be poured out around the bones as a provisional callus. The true reparative products are chiefly poured out by the periosteum and endosteum, though the soft parts around at times add their quota. In the flat bones, the ossification of this reparative material has a preliminary fibrous tissue stage, and in the long after the blood has been absorbed, the cell infiltration passes on to the formation of connective tissue or *neoplasm* which subsequently ossifies, in rare cases passing through the stage of fibro-cartilage. In children, it is probable that the cartilaginous stage always precedes the osseous, while in adults, the bone is poured out at once, which is probably always the case in all rapidly repairing fractures.

Ossification may take place in the periosteal blastema or in the endosteal or in both—these points being greatly determined by the relative position of the broken ends of the shaft of the bone and the comminution of the fragments; great displacement and separation of the fragments being bridged over or cemented together by irregular masses of connecting bone tissue.

When immobility of the broken bones has not been maintained, the bone cement or provisional callus will be very extensive. In the ribs where it is impossible to prevent movement, there is always some ensheathing callus; indeed, Dupuytren's ring of provisional callus is constant. In the clavicle also it is common. In other bones, it will vary with the amount of movement that has been allowed in their treatment. When the movement is very great, the process of ossification will not go on kindly, and ligamentous or fibrous union will remain, giving rise to an ununited fracture, and occasionally a false joint is formed. (A splendid example of this is represented in Fig. 480.) The rapidity with which ossification or true bony union is obtained in fracture depends much on the degree of immobility insured to the broken bones and the constitutional power of the patient.

The period in which the several parts of the reparative process are usually completed after fractures of adult human bones are reckoned thus according to Paget:—To the second or third day after the injury, inflammation in and about the parts; thence to the eighth or tenth seeming inaction, with subsidence of inflammation; thence, to about the twentieth, production of the reparative material, and its gradual development to its fibrous or cartilaginous condition; thenceforward its gradual ossification, a part of the process which is most variable in both its time of commencement and its rate of progress, and which is probably rarely completed before the ninth or tenth week.

In open or compound fractures, repair goes on very much in the same way as in simple, and when they are made simple by sealing the wound, precisely in the same way. When the wound is left open and suppuration takes place in the soft parts around the broken fragments, repair goes on through granulation, the granulation tissue subsequently ossifying and passing into bone-cells; the process of repair under these circumstances being more gradual than where the reparative material is poured out between the broken bones, and goes on directly to ossify.

At times after a simple fracture, but more commonly after a compound, the fractured bone inflames, and, as a result, the broken fragments die wholly or in part, repair is retarded and cannot be performed until the necrosed bone has been cast off or removed. In comminuted compound fracture, this result is more common than in less complicated cases. In gunshot injuries of bones this comminution of the bone is the chief point of difference between them and other compound fractures.

Compound fractures, as a rule, require for their repair three or four times the period required in simple.

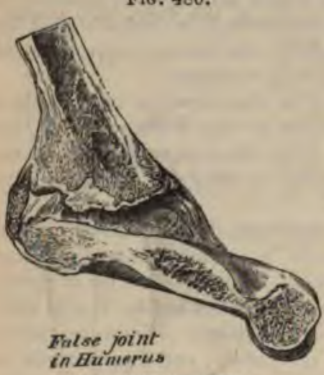
Ununited fractures are met with, when, from any local or general cause, ossific union is delayed or does not take place between the broken ends of the bones, and in by far the bulk of cases, this is the result of a want of that complete rest and quiet which is so essential for the ossific union of a broken bone. When the ends of the broken bone are kept asunder, ossific union is likewise sure to be retarded or prevented, and also when any muscle or fascia is placed between the broken fragments. In feeble cachectic and syphilitic subjects the same want of repair may likewise be met with.

Failures in the reparative process depend therefore on some failure in the general power of the patient, want of care in the local treatment of the case, or on some local cause. The union, however, is, as a rule, simply delayed.

Hamilton calculates that such delayed union occurs once in 500 cases, but this average I believe to be too high. It is chiefly found, according to Norris ('Amer. Journ. of Med. Sciences,' 1842), in the thigh, leg, arm, forearm, and lower jaw. I have seen it, however, in the clavicle and in the ribs, and cases are recorded in which it was met with in the spine.

In the majority of cases, the union of the broken bones is by fibrous tissue which has failed to ossify. In Prep. 1110^{80}, Guy's Museum, this condition is well exemplified, the ends of the bone being pointed and firmly joined by ligamentous tissue. The length of this tissue varies in different cases. In exceptional instances, the ends of the bone are rounded and inclosed by a strong capsular ligament, and thus a false joint is formed, which is well exemplified in a specimen of fracture of the forearm (Guy's Museum, 1119^{20}), but still better in that of the humerus (Prep. 1110^{85}), (Fig. 480) in which the ends of the bone are studded with fibro-cartilage, and complete movement existed.

FIG. 480.



Prep. 1110^{85}, Guy's Mus.

In more rare cases there is a total absence of all uniting medium.

TREATMENT.—Regarding a large majority of cases of ununited fracture, as examples of delayed union, due to a want of that absolute immobility of the fractured limb which is so essential for its repair, the most essential point to be observed in treatment is, the application of an absolutely immovable apparatus, which may be found in one of the forms of splint described as immovable, such as that of starch, egg and flour, chalk, plaster of Paris, or liquid glass, with gutta-percha, millboard, zinc, or felt; the joints above and below the broken bone being included in the apparatus, while tonic constitutional treatment is at the same time observed.

When the limb is thus firmly fixed, rest and the non-use of the limb is scarcely necessary; indeed, under certain circumstances, the moderate use of the limb seems to be beneficial, and in several cases under my care, repair seems to have been hastened by such a license. John Hunter saw the truth embodied in these remarks, having asserted in 1787: "When the uniting process in fractures is backwards, the parts should *not* be kept at perfect rest. I have seen fractures of the leg which would not otherwise unite, do so after patients were up on their legs, the fractured bones being well supplied with iron splints, &c." (MS. Lect.). When these means fail, the ends of the bone may be well rubbed together to excite action before the re-application of splints, or subcutaneously scored with a tenotomy knife, while in still older cases the bones may be fastened together by means of wire sutures, or drilled and secured with ivory pegs, the credit of this latter suggestion being due to Dieffenbach. Dr. Physick, of Philadelphia, years ago (1804) suggested the introduction of a seton between the ends of the broken bones, and Norris reports that good success has followed the practice, 54 out of 72 cases being successful. The object of the treatment is to excite local action between the fragments, and when this is secured, the seton may be removed. With the same view Malgaigne introduced acupuncture needles between the bones, and Miller and M. Blandin subcutaneously scraped with a tenotomy knife the ends of the bones or the connective tissue.

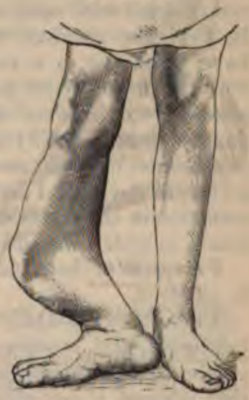
Resection has also been practised, and, according to Norris, with success in thirty-seven out of sixty-four cases. The operation, however, is formidable, and should only be undertaken where there is no hope of minor measures being successful, the ends of the fragments being far apart, and the condition of the limb such as to render some risk justifiable to gain the desired end. I have performed this operation for ununited fractures of the femur and humerus with excellent results.

Dr. H. J. Bigelow, of Harvard, has, however, met with considerable success in detaching the periosteum for about half an inch from the extremities of the affected bone with the muscles, taking off the ends of the bones and securing the resected portions together by strong wire passed through half the thickness of the shaft of either fragment; the periosteal flaps may also be united by sutures. The limb should then be fixed on a splint. The wire can be left in place without fear from two to six months. He cured ten out of eleven cases where this operation was performed. ('American Journ. of Med. Sciences,' 1867.)

It occasionally happens that a fracture which had united becomes disunited after fever, scurvy, or other enfeebling cause, and I have had one very marked case of this in the person of a young lady who had her thigh fractured abroad, and subsequently became the subject of tropical fever. In her case, although the bond of union completely gave way, she subsequently obtained a firm limb by means of local immobility and constitutional tonics. These cases ought to be classed with others in which the cicatrices of burns or old ulcers break down under some enfeebling influence, and heal under tonic and general hygienic treatment. In the treatment of all these cases time ought not to be estimated too closely.

The *deformities that follow badly united fractures* require at times surgical treatment, and, when the surgeon is consulted during the first few weeks of the case, chloroform should be given and the bone re-fractured and set in good position—it being quite justifiable to employ considerable force to attain this end. In young subjects, this re-fracture is rarely attended with difficulty, while in the adult, some is usually found. Œsterlen and Skey were strong advocates for this practice, the former having employed it up to the twenty-fourth week, and the latter on a boy, æt. 15, thirteen months after the fracture.

FIG. 481.



Hyperostosis after green-stick fracture.

When the bone has united too firmly to permit of re-fracture, it should be divided by a subcutaneous section, or by some cutting operation. Key did this latter operation in the leg, in 1839 ('Guy's Hosp. Rep.,' series i, iv), and Lister more recently has done the same ('Brit. Med. Journ.,' 1868). The subcutaneous section should be performed in a similar way to that adopted by W. Adams in dividing the neck of the thigh-bone with a saw or chisel.

These operations, however, are only to be undertaken when the local deformity is great and the limb useless.

In the incomplete or green-stick fractures of infancy, if the bone be not straightened, strange deformities ensue. In the case depicted in Fig. 481, such a result was to be seen, the bent tibia and fibula having been much thickened by the deposition of bone in the concavity of the arch, the bone measuring across its centre six inches. It was taken from a girl, twelve years old.

SPECIAL FRACTURES.—FRACTURES OF THE UPPER EXTREMITY.

Fractures of the cranium and spinal column have already received attention; those of the lower jaw have been described in page 397, and those of the nose and sternum in chapter xvii.

Fracture of the clavicle is generally the result of indirect violence such as a fall upon the shoulder, and when of direct it is usually compound or comminuted. Hamilton and Gurlt record examples from muscular action, aad I have seen one in a man, æt. 44 (who had had syphilis nine years before), from simply lifting a heavy weight from the ground. The bone broke near the sternal end with a snap, and a good recovery followed. The case was brought under my notice by Mr. Couling, now of Brighton, when house-surgeon at Guy's. The statistics of the Middlesex Hospital, as compiled from the experience of sixteen years, by Messrs. Fowler and Hulke (Holmes's System,' vol. ii), prove the clavicle to be more frequently broken than any other single bone, the radius standing next in order, although, including fracture of the radius with the ulna, the fracture of the clavicle stands second. Half the recorded cases occurred in children under five years of age

The bone, as a rule, is broken about its centre, although fractures of either extremity are met with. The line of fracture with rare exceptions is oblique from without inwards, and from before backwards; the inner fragment having commonly a tendency to ride over the outer, the outer falling downwards and backwards.

The *symptoms* are generally well marked. There will be inability to move the arm freely, with pain in the attempt, the patient supporting the arm of the affected side. On comparing the shoulders of the two sides, the joint on the affected will be placed lower and more forward than on the sound, and, at the same time, drawn nearer to the median line of the body, even for an inch where the displacement is great. On passing the finger over the broken bone some depression and corresponding elevation of the broken fragments will be made out, and when the examination is made after the expiration of days with the effusion of much solid material. *Crepitus* can sometimes be detected, but it need not be looked for—this symptom, with the amount of displacement, depending much upon the line of the fracture and its situation.

Dr. R. Smith, of Dublin, points out ('Treatise on Fracture,' 1850), how in fractures of the acromial end of the bone between the conoid and trapezoid ligaments, there is scarcely any displacement of either fragment; and, under these circumstances, the diagnosis has to be made by pain produced on pressure over the broken point, and the crepitus educed by the movement of the bones in opposite directions through the fingers. He also shows, how in fracture external to the trapezoid ligament, the inner fragment being drawn upwards by the trapezius muscle, the displacement is great.

In children, *incomplete* fractures of this bone may occur (Fig. 476).

Fractures of the clavicle are sometimes comminuted and compound, and occasionally complicated with some severe injury to the vessels beneath. In the case of the late Sir R. Peel, the accident was followed by a pulsating blood-tumor which was supposed to have been due to a rupture or laceration of some large vein, probably the subclavian, while from the severe pain that attended the injury, some of the nerves of the brachial plexus were believed to have been injured. Mr. Erichsen has recorded ('Brit. Med. Journ.,' June 7, 1873) a case, in which the subclavian vein was compressed by a fragment of a broken clavicle, and in which amputation of the shoulder-joint was performed on the sixteenth day, and I have seen one in which a broken clavicle was followed by arrest of pulsation in the artery of the corresponding arm. At St. George's Hospital, there is a specimen in which the end of the fractured bone was driven through the internal jugular vein.

Fractures of both clavicles have also been recorded. I have seen this more than once in children.

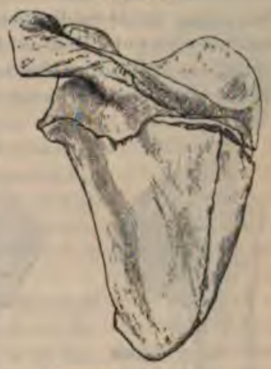
TREATMENT.—Daily experience proves that fractures of the clavicle unite without any treatment, and, moreover, by palpable deformity shows that where treatment has been employed, the union is neither perfect nor satisfactory. Daily experience likewise proves, that in most, if not all cases of fracture of the clavicle, the bones fall well into place on the patient assuming the recumbent position. In young ladies, and in others where it is a matter of importance to prevent deformity, this recumbent position in bed may be maintained for about three weeks till union has fairly taken place; but children and men will rarely be found willing to follow such a line of treatment, and happily it is not required, for nearly, if not quite eqally good results will be secured by imitating what takes place on the patient assuming the recumbent position, viz., by fixing the lower blade of the scapula to the chest, binding down its angle to the thorax, and thus preventing the tilting forwards and rotation of the bone through which the deformity takes place.

The plan I have now adopted for some years is, to place a pad over the blade of the scapula below its spine, and to bind the bone firmly to the thorax by means of broad strips of strapping obliquely encircling half the chest from the spine to the sternum, at the same time supporting the affected arm in a sling, and drawing the hand upwards towards the opposite shoulder. This same method is also advocated by Dr. E. Hartshorne, of Pennsylvania. Whilst the strapping is being fixed, the scapula should be well tilted backwards by elevating the arm, or, the patient should be kept in the recumbent position. When this practice cannot be followed, the elbow should be brought forward to a point below the nipple of the affected side and the hand drawn over the opposite shoulder. The old plan of fixing the pad in the axilla and using a figure-of-eight bandage is of no benefit, and, moreover, causes much discomfort to the patient.

The axillary pad of Desault is, at times serviceable, and may be employed, being easily fixed by a broad piece of strapping made to encircle the shoulder. In addition to the pad, Professor Gordon, of Belfast ('Dublin Quart.,' 1859), recommends the injured arm to be extended downwards and firmly fixed to the body by a bandage, permanent extension being kept up by means of a band fastened above to the forearm flexed at right angles, and below, around the perineum or upper part of the thigh.

Fractures of the scapula, probably, are always the result of direct violence, although a fracture of its neck may be produced by a fall upon the shoulder.

FIG. 482.



Fracture of scapula.
Prep. 1097^{50}, Guy's Mus.

The *body* of the bone may be fissured in any direction (Fig. 482), though much displacement is rare.

In this accident, mobility of the broken bone and crepitus may usually be made out by manipulation; though in fat subjects and when effusion exists the diagnosis may be difficult.

TREATMENT.—A broad pad carefully adjusted and kept in position by means of broad strips of plaster encircling half the thorax, the arm being kept quiet and the elbow raised in a sling, is usually sufficient treatment, although a good shield of gutta percha or felt may be sometimes beneficial.

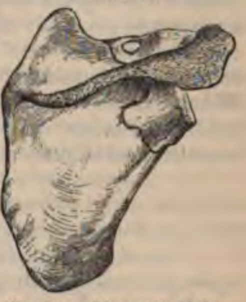
The *acromion process* may be fractured across its base or in any other part, and, when it is so the outer fragment is generally drawn downwards with the arm, producing a dropping of the shoulder. The accident can readily be made out, on tracing the spine of the scapula outwards, by the deformity, the break in the normal line of the bone, and the local pain, if not by the separation of the fragments. There is also loss of power in the arm and alteration in its outline.

It should be treated by raising the elbow by means of a good sling or bandage, a small axillary pad and a circular bandage binding the arm to the thorax. The union, however, is often ligamentous, it being impossible to keep the fragments of bone closely in apposition.

Fracture of the *coracoid process* are remarkably rare. I have seen but one decided instance, and that in a girl, æt. 15 or 16, the result of a blow. There was local pain and crepitus to denote the injury with displacement of the process, its point being drawn downwards by the biceps muscle, and its base projecting. It is more commonly associated with dislocation of the humerus.

TREATMENT.—The muscles attached to the process must be relaxed, the biceps by flexing the forearm, and the coraco-brachialis by drawing the arm forwards and inwards. In this position, the arm should be bound by a bandage, the bone itself, if possible, being restored to its normal position by manipulation.

FIG. 483.



Fracture of the neck of the scapula.

Fractures of the *neck of the scapula* or of the *glenoid fossa* must be rare. Sir A. Cooper described such cases, but since Malgaigne showed how the symptoms described might be produced by dislocation of the shoulder with fracture of the glenoid cavity, some doubt has been thrown upon the question of a simple fracture of the neck of the bone ever occurring. In Guy's Museum, prep. 1097^{85}, there is a specimen of fracture of the neck (Fig. 483), and in the Royal College of Surgeons there is a second, the third being recorded in Du Verney, 'Traité des Maladies des Os,' 1751. Sir A. Cooper gives the flattening and sinking of the shoulder, the prominence of the acromion, the elongation of the arm, and the presence of crepitus as the chief symptoms, the head of the humerus being felt in the axilla. He also relates how the arm may be replaced in its normal position and again displaced on allowing the arm to drop, this symptom being the chief one of diagnosis between the supposed accident and dislocation but, when dislocation of the head of the humerus exists with fracture of the glencoid fossa, the same symptoms are found. The subject, therefore, requires further elucidation. In suspected cases of this kind the elbow should be raised, in order to press the head of the bone well upwards into position, and kept there by sling and bandage.

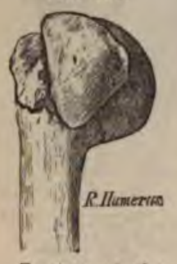
I have seen a case of dislocation of the head of the humerus downwards and forwards, complicated with a fracture of the lower portion of the glenoid cavity, the broken piece being drawn downwards.

Fractures of the humerus form about one-seventh of all fractures, and are about half as frequent as fractures of the clavicle and scapula together. They are commonly the result of direct violence, and occasionally of muscular action. They may be divided into fractures of the *head* and *tuberosities*, *shaft*, and *condyles*.

Fractures involving the *head* and *tuberosities* are usually the result of a blow or a fall upon the shoulder, although occasionally they follow falls on the elbow. In a case that came under my care in 1877 and died from other injuries, the greater tuberosity was crushed off and displaced upwards from a fall upon the shoulder. This accident could never have been made out during life. In all cases, the direction of the violence is an important point to discover, as by it the surgeon obtains the best guide to the position of the fragments as well as the nature of the injury.

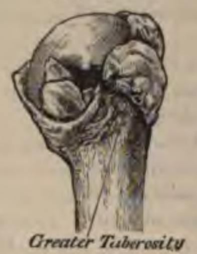
When the line of fracture follows that of the *anatomical neck*, it is intracapsular; and when it occurs, the head of the bone may be completely separated and left as a foreign body in the joint; yet such cases are very rare. In others, such as Fig. 484 illustrates, the head is separated and the tuberosity fractured; more commonly, however, the fracture is *impacted*, the lower fragment being either driven into the head of the bone, or the head driven into the neck, the greater tuberosity, as a rule, being broken (Fig. 485). Dr. R. Smith, of Dublin, states that when this accident exists, the arm is shortened, the acromion process projects, the shoulder loses its rounded form, the shaft of the humerus approaches the acromion, and the head of the bone cannot be felt. When the tuberosity is broken off, crepitus may be detected.

Fig. 484.



Fracture of the head and tuberosities of the humerus. Poland's case.

Fig. 485.

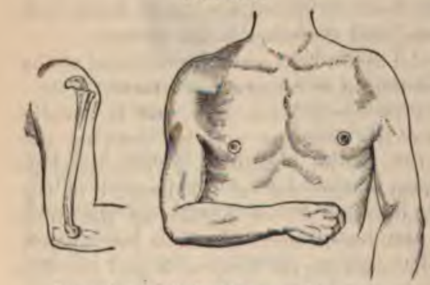


Impacted fracture of the head of the humerus. Prep. 1113^{80}, Guy's Mus.

In 1868, I saw such a case in a woman, æt. 59, who had fallen on the shoulder nineteen days previously, the case having been treated as one of contusion. Shortening in the arm of three-quarters of an inch, and a distinct prominence of bone with thickening could be felt between the acromion and coracoid processes; while the head of the bone rotated freely in the glenoid cavity. In it, there was some flattening of the deltoid. A good recovery took place with permanent shortening. I saw also a similar case in 1865, in an old man æt. 82, in which good repair took place.

More commonly a fracture about the head of the bone means a *fracture in the line, or a separation of the epiphysis*, the epiphysis including the head and the tuberosities. This accident is generally the result of a fall on the elbow, and the symptoms of the accident are tolerably distinct. The head of the bone can be felt in its normal position, but is not movable on rotating the shaft, while the end of the displaced shaft is usually sent forward. When fractured, the bone presents a sharp edge and outline; but when displaced—an accident that can only occur in subjects under twenty-one—the end of the bone appears rounded and slightly convex. It is, moreover, drawn forward by the action of the pectoral muscles, and made to project beneath the coracoid process in a marked and characteristic manner. In Fig. 486, taken from a male patient of mine, æt. 16, this is well seen.

Fig. 486.



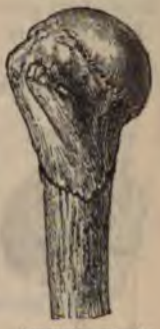
Separation of shaft of humerus from upper epiphysis.

When the separation is complete, the displacement will be very marked. When partial, it will be equally characteristic, but, in partial dislocation of the shaft, some mobility of the head of the bone will exist. In this accident the shaft may be at times replaced by manipulation, "but the moment the parts are abandoned to the uncontrolled action of the muscles the deformity recurs."—*R. Smith.*

When impaction of either fragment exists, no crepitus will be felt unless forcible movement be made, when it may be elicited. Care, however, should be observed in seeking for this information, as a forcible separation of the impacted bones is a fatal error. The accident is generally to be made out by the nature of the injury, the shortening of the limb, the absence of crepitus, and the movement of the head of the bone on making gentle rotation of the shaft.

In fractures of the *anatomical neck* when the head of the bone is driven into the tuberosity and shaft, as in all other forms of impacted fracture, union will go on if the impacted bones are not displaced by manipulation. The surgeon, therefore, has only to apply some simple splint, such as an anterior and posterior or lateral, or Stromeyer's cushion (Fig. 500), to maintain rest, and the same treatment is applied in fracture or separation of the epiphyses when the bones have been replaced. In the case illustrated in Fig. 486, a capital arm existed.

Fig. 487.



Fracture of the surgical neck of the humerus. Prep. 1107^{37}.

Fracture of the surgical *neck of the humerus* below the tuberosities is, however, probably the most common form of accident, and the line of fracture may be transverse or oblique (Fig. 487). In it, when the bone is broken above the insertion of the pectoral muscle—its usual seat—the lower fragment is drawn *inwards* towards the chest, whilst the upper fragment is drawn upwards and *outwards* by the muscles that are inserted into the tuberosities. The bone projects forward or backward according to the direction of the fracture, the direction depending greatly upon that of the force. The more oblique the line of fracture, the greater the deformity. Impaction of the broken fragments may occur in this as in the last fracture, the lower usually penetrating the upper.

When, after a separation of the upper epiphysis or fracture through the tuberosities or neck of the bone, the upper end of the diaphysis or the lower fragment of the broken bone is drawn inward and forward by the pectoral muscles, the case may simulate that of dislocation. The mistake, however, should not be made, as in the early period of the accident increased mobility of the bone and crepitus should be enough to indicate its nature; and, in the later period when the deformity produced by the end of the lower fragment is visible, the accident is palpable.

Treatment.—The nature of the accident having been ascertained and the question of impaction or non-impaction decided, the treatment becomes simple, for in the *impacted* fracture whether of the anatomical or surgical neck, the aim should be to keep the impacted bones in position and to prevent their being loosened so that natural processes may effect a cure in a month or six weeks with a limited degree of deformity; and, in a *non-impacted* fracture, the first aim is to bring the bones into as good apposition as possible, and to keep them there by means of splints and position. In doing this the tendency of the fracture has to be considered, which is that the lower fragment is drawn inwards by the pectoral muscle, and the upper fragment outwards by the scapular muscles. The best plan to carry out these objects is to fix the arm between any inside right angular and outside straight splints, the former extending from the axilla to the wrist, and the latter to the elbow, the two being bound well together. It is a dangerous practice simply to place the forearm in a sling and bind the arm to the side. When much injury to the soft parts or any wound exists, it is an excellent plan to draw the arm outward from the body at half a right angle and to rest it on the splint with the forearm partially flexed, care being taken that the lower fragment is not drawn too far inward, or to bind it on Stromeyer's cushion.

At other times, a good gutta-percha, felt, or leather casing, moulded to the shoulder and arm is very efficient. Erichsen advises a bent leather splint, the angle being well pressed into the axilla, with one half fixed to the arm, and the other to the thorax.

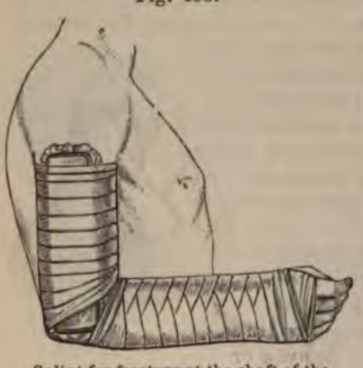
In all these cases the surgeon should explain to the patient that some impairment of the mobility of the limb may be expected, and some shortening in impacted fractures.

Fracture of the greater tuberosity is a recognized accident, and is usually associated with dislocation of the humerus forwards, the scapular muscles drawing the tuberosity backward. Dr. R. Smith, in his excellent work on Fractures, gives a description of two of these cases. He describes a remarkable increase in the breadth of the articulation, the projection of the acromion and flattening of the deltoid, as the most striking features of the injury. He also draws attention to the *vertical sulcus* corresponding to the bicipital groove, formed by the head of the bone on the inner side and the displaced tuberosity on the outer, as one of the characteristic symptoms.

Fractures of the shaft of the humerus are common, and more readily made out as well as successfully treated than any other fracture. When oblique, they are frequently followed by some degree of shortening, but this result is of little practical importance, as it interferes but slightly with the functions of the hand. Such fractures are as commonly the result of direct as of indirect violence, muscular action being by no means an uncommon cause. I have already mentioned an instance in which it occurred in a man in a marital embrace, and a second produced by throwing a ball. Lonsdale, Malgaigne, Hamilton, and others have recorded similar instances.

When the fracture is transverse, there is no displacement. When oblique, the tendency of the lower fragment to ride will depend upon the line of the obliquity and its position. When the line of fracture is below the insertion of the deltoid, the upper fragment will have a tendency to be drawn outwards; when above this point, the upper fragment will be attracted inwards by the pectoral muscles, the lower fragment being drawn upwards and outwards by the deltoid.

Fig. 488.



Splint for fracture at the shaft of the humerus.

Loss of power in the arm, mobility of the bone, crepitus, local pain, and deformity are ample symptoms to indicate the accident. An error in diagnosis ought not to occur.

TREATMENT.—This is not really difficult, although from the fact that united fracture is more frequently found in this bone than in any other, it would appear as if the practice were less successful. In a measure, this conclusion must be regarded as correct, and I would explain it by the want of a due appreciation of Boyer's rule of treatment, viz., to keep the joints above and below the broken bone in absolute rest; for in fractures of the arm, the common practice of applying splints to it, and allowing perfect freedom to the action of the forearm, is to be condemned; because in moving the forearm the triceps and brachialis anticus with the biceps, have as powerful an action upon the humerus as upon the bones of the forearm.

In the primary treatment of all fractures of the arm, it is a wise and scientific practice to keep the forearm at rest, which is best done by the application of some angular splint extending from the shoulder or axilla to the wrist, associating with it a posterior or anterior short splint reaching from the shoulder to the elbow (Fig. 488). After about two or three weeks the angular splint may be removed, and some immovable one applied, the forearm being left free.

Any splints that secure immobility of the broken bone after its ends have been coapted by manipulation must be regarded as beneficial, and no splints can do this effectually that allows freedom of movement of the forearm. When two lateral splints appear the more adapted to keep the bones in position, they must be angular, to include the elbow, and bent at a right angle.

The incomplete or green-stick fractures of children are well treated by millboard, gutta-percha, or felt splint, after the bone has been restored to its normal position.

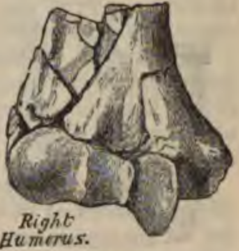
In putting up fractures of the arm, care should be observed not to press upon the musculo-spiral nerve as it winds round the bone, especially when the line of fracture corresponds to its position.

Fractures involving the lower end of the humerus whether transverse above or vertical through the condyles, or both together; whether complicated with separation of the epiphysis or some displacement of the bones of the forearm, are always difficult to diagnose and to treat; and when the joint is involved either by the fracture running into it or by displacement, there is usually some subsequent imperfection in its movement.

Fractures above the condyles where the bone is thin and expanded, whether in the child or adult; or separation of the lower epiphysis (an accident of early life) are usually produced by some fall upon the elbow. When the line of fracture is oblique from behind forwards the action of the biceps and brachialis anticus has a tendency to draw the forearm with the lower fragment upward and forward. When the line of fracture is oblique from before backwards and upwards, the lower fragment of bone with the bones of the forearm is apt to be drawn backward by the action of the triceps, thereby giving rise to the external appearance of a dislocation of the bones of the forearm backwards, since there is the same projection of the olecranon process and hollowness above it, the [illegible] jection of the lower end of the humerus forwards, with the prese [illegible] in both accidents. There is, however, this great di [illegible] dislocation, so well expressed by Sir A. Coo [illegible] removal of all marks of dislocation on exte [illegible] discontinued;" crepitus of a marked kin [illegible] suppressed kind where a displacement of the epiphysis exists; whereas in dislocation, no crepitus is present, and there is marked immobility of the bones, the bones of the forearm and the condyles of the humerus having lost their natural relative position. Malgaigne also pointed out, that in fracture there will be a shortening between the acromion process and the internal condyle, whereas in dislocation there will be none. In fracture, the anterior projection of the end of the humerus is *above* the fold of the elbow, and not so broad or round as in dislocation, where it is *below* it.

Fracture of the condyles into the joint is a grave accident, and likely to be followed by some stiffness of the joint. It may be oblique in any direction, the outer or the inner condyle being fractured or associated with a transverse fracture of the bone (Fig. 489). The existence of the fracture can be made out by manipulation, the amount of displacement varying with the character of the injury. Crepitus can also be detected by grasping one or other condyle and moving the broken fragment, while rotation of the radius often gives rise to it when the external condyle is involved. Flexing the ulna also produces it when the internal condyle is affected.

Fig. 489.

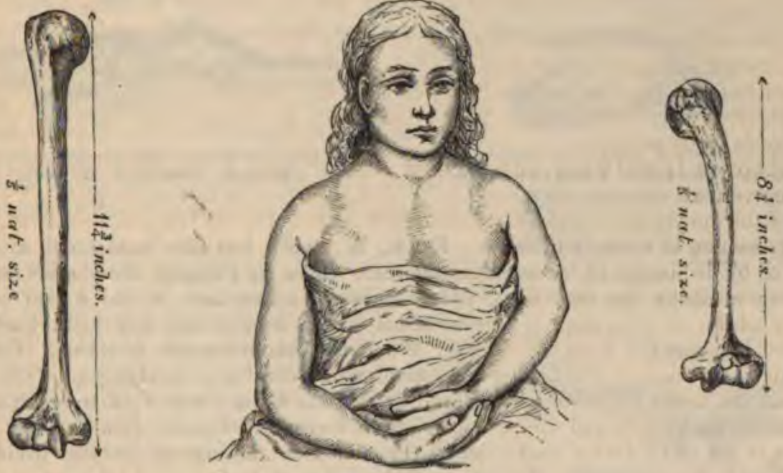


Comminuted fracture of the condyles of the humerus. Prep. 1112^{75}.

All these fractures into the elbow-joint are rapidly followed by effusion, which often masks the symptoms and renders the diagnosis difficult and uncertain. Under these circumstances no diagnosis should be attempted until by rest and cold applications the effusion has been absorbed and a full examination can be satisfactorily made. A few days are usually enough for this change to take place. In rare cases, the inner condyle is simply chipped off, the joint not being implicated.

Treatment.—In all these cases of fractures involving the condyles of the humerus whether into the joint or not, the fragments should be brought into position by extension upon the forearm when needed, with manipulation, and an anterior jointed rectangular splint applied; the upper half of the splint being well passed up the arm, and the lower to the wrist. In some cases, a posterior arm splint projecting down to the olecranon process is of use, the whole being well bound together and to the limb. The joint, as a rule, may be left exposed for external applications. Some surgeons prefer from the first an immovable casing of gutta-percha or felt, while others, lateral leather or pasteboard splints, but I think it preferable to leave the joint exposed.

Fig. 490.



Right humerus. Arrest of growth in the humerus after fracture in early life. Left humerus.

In children, the bones unite in about three weeks, and in adults, after a month; consequently all splints should be removed at the end of these periods, and passive movement allowed. Hamilton, however, in his great work on Fractures, states his belief, that passive movement ought to be commenced within seven days and perseveringly employed until the cure is accomplished. He does not admit the use of splints after this period, believing that the new material has steadied the fragments, and that the danger of displacement is but little, while the prevention of anchylosis demands early and continued motion.

After fracture of the humerus as of other bones, arrest of growth may follow. I have seen such an arrest of growth in the humerus of a woman, to the extent of three and a half inches, after a fracture of the shaft which occurred when she was about eight years of age (Fig. 490). I have also recorded ('Guy's Hosp. Rep.,' 1862) a case, in which with a stiff shoulder-joint, the humerus was five inches shorter than its fellow, in a woman æt. 30, the shortening having followed some injury to the upper part of the bone during infancy. In the first case, the arrest of growth was probably due to some injury to the nutrient artery of the bone, in the second, to injury to the epiphysial cartilage at the upper part of the shaft.

Fractures of the bones of the forearm.—These form about two-fifths of all the fractures, half the cases consisting of fracture of the radius alone, a fourth of fracture of the ulna including the olecranon process, and the remaining fourth of the two bones together; fracture of the radius and ulna together being about equal in frequency to that of the clavicle.

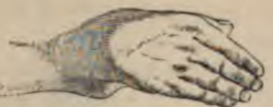
Fracture of the radius may take place at its head, neck, shaft, or lower end. When of the neck or shaft, and transverse, the fragments of bone are usually loose, yielding on manipulation a distinct crepitus, the head of the bone being felt not to rotate in its position; but, when the head of the bone is fissured longitudinally no such symptoms will be present. Fractures of the lower end of the bone are of a very variable nature; a large number of them are impacted, the compact shaft of the bone being driven into the cancellated carpal extremity. When impaction does not exist, it is from comminution of the lower fragment.

In a case of injury to the right upper extremity in a man æt. 30, complicated with brain mischief which came under my care in 1877, there was an impacted Colles's fracture of the right radius and a vertical fracture of the head of the same bone into the joint. He had evidently fallen from a height upon his right hand and head.

Fractures of the lower extremities are generally the result of a fall upon the hand, and are very common. Fractures of the shaft or neck may be produced in the same way, but are more commonly caused by direct violence.

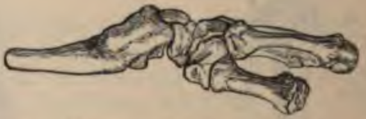
Fractures of the lower end have always been of special interest. Colles, of Dublin, first described them in 1814 ('Edin. Med. and Surg. Journal'), and such injuries are now generally known as Colles's fracture. Dr. R. W. Smith has also done much to draw attention to their nature in his work on fracture, where he explains the characteristic deformity by muscular action. Figs. 491–2 show the appearance of the wrist; with displacement of the broken end and hand backwards; Fig. 493 shows displacement forwards. Callender, however, more recently, in an able paper ('St. Barth. Rep.,' 1865), has shown that Voillemier, Malgaigne, and Nélaton's views are the more correct, and that *impaction* rather than muscular action is the true explanation of the deformity.

Fig. 491.



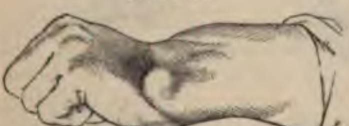
Colles's fracture of lower end of radius and displacement backwards. Dorsal view. From Dr. R. W. Smith.

Fig. 492.



Fracture of radius and displacement backwards. Side view. From Dr. R. W. Smith.

Fig. 493.

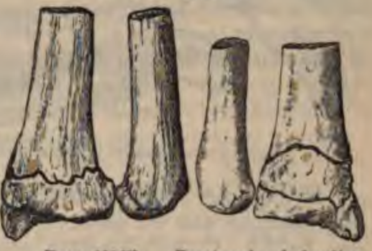


Fracture of radius and displacement forwards. From W. Smith.

"The radius is first broken, then, by the momentary continuance of the force in the direction of the falling body, forwards and outwards, the shaft is driven into the carpal end, burying itself chiefly from the dorsal surface towards the palm, and towards the outer or the inner side. In a great number of cases this impaction so fixes the fragments that they cannot be unlocked, and the deformity is permanent."—*Callender*. The thirty-six specimens of fracture of the lower end of the radius which the museums connected with the London schools of medicine contain, clearly manifest that the cause of each deformity is the impaction of the proximal in the distal portion of the broken bone.

The fracture is usually placed about half an inch or an inch above the wrist-joint, and the lower fragment or epiphysis is displaced backwards. It is, moreover, so displaced that the articular facet instead of looking downwards, forwards, and inwards is made by rotation to look downwards, backwards, and outwards. The outer side of the fracture towards the styloid process is rotated more than the inner, the strong ligaments uniting this with the ulna holding the bone more in position. On this account the lower fragment is often also broken vertically, giving rise to greater deformity as well as to shortening of the bone on its outer border. In some cases, the end of the bone is comminuted (Guy's Museum, 1119^{32}), and Fig. 494 illustrates a case of fracture of both radii from a fall on the hands.

Fig. 494.

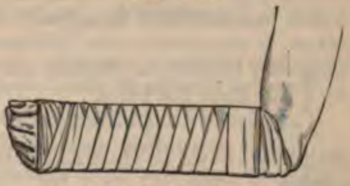


Prep. 1118^{29}. Fractured end of radius. Prep. 1118^{30}.

The *diagnosis* of this accident is not difficult; indeed, the aspect of the wrist may be said to be characteristic. "The posterior surface of the limb," wrote Colles, "presents a considerable deformity; for a depression is seen in the forearm, about an inch and a half above the end of the bone, whilst a considerable swelling occupies the wrist and metacarpus; indeed, the carpus and base of the metacarpus appear to be thrown backwards so much, as, on first view, to excite a suspicion that the radius has been dislocated forwards. On viewing the anterior surface of the limb we observe a considerable fulness as if caused by the flexor tendons being thrown forwards; this fulness extends upwards to about one-third of the length of the forearm, and terminates below at the upper edge of the annular ligament of the wrist. The extremity of the ulna is seen projecting towards the palm and inner edge of the limb." The amount of deformity turns upon the amount of displacement of the broken fragments. There will be pain in the part, increased by pressure on the seat of fracture and about the internal lateral ligament; the movement of the joint being rendered impossible. On feeble movement of the hand, the head of the radius will be felt to rotate, the fracture being commonly an impacted one; crepitus will either be absent or very indistinct, and can only be well brought out by loosening the broken bones—a very questionable proceeding, especially in old subjects.

TREATMENT.—In all fractures of the radius, it is essential to keep the hand at rest, and, as a consequence, all splints should extend at any rate down to the base of the fingers. In fractures of the neck or shaft, the elbow should be bent at right angles and the hand held midway between pronation and supination; two well-padded broad splints extending down to the fingers being firmly fixed on by strapping, broad bands, or a roller (Fig. 495). When, as in fractures of the shaft, there is a disposition for the fragments to fall inward, some extra pad may be employed.

Fig. 495.



Splints for fracture of forearm.

The splints should be removed after three weeks, and freedom given to the hand, movement of the muscles being encouraged; shorter splints or some immovable apparatus should also be substituted down to the wrist whilst union is being consolidated. Lateral pressure of the bandages must always be avoided.

In fractures of the lower extremity of the radius the old-fashioned pistol-shaped splint is still in favor with some, its object being to keep the hand and wrist adducted, and thereby to counteract the deformity that so commonly attends this form of fracture. Some surgeons, and more particularly the American, apply it to the palmar, and others, including Nélaton, to the dorsal aspect, with a shorter second splint. I am no believer in its virtues, for if the fracture be impacted, and the fragments are not loosened, it is useless, as union has only to go on between the impacted fragments for a cure to be effected; and when the fragments are loosened and the bones brought into apposition by extension and manipulation, the pistol splint is not wanted, indeed, it is probably injurious, causing displacement of the broken bones. A well-padded broad anterior splint, reaching to the

[illegible]

[illegible]

TREATMENT.—In fractures of the shaft the treatment is

splint and preventing shortening. The surgeon has only to

kept quiet, and that the fragments are in position. This is

padded anterior and posterior splints, the hands being fixed

pronation and supination.

In fractures of the coronoid process, the forearm should

brachialis anticus muscle which is inserted into it; and in

nearly straight, to relax the triceps, through which the separat

place. The splint may be strapped on or fixed by strapping

immovable apparatus is advisable.

Some separation of the fragments very frequently remain aft

which increases when the arm is used too soon, the power of

weakened. Passive movement of the arm, however, should

five weeks after the accident, all violent efforts being condemn

Fracture of both radius and ulna occurs about as f

ulna alone, but not a quarter so often as fracture of the radi

usual cause, a fall upon the hand being more commonly follow

than of the two bones.

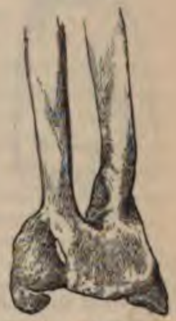
Malgaigne has recorded instances of this accident from muscular action. In infants, the "*green-stick*" or "*incomplete*" fracture of both bones is not infrequent.

The fracture may be transverse, oblique, or comminuted, and the displacement of the fragment may vary vastly according to the direction and violence of the force which produced it.

These fractures are readily made out, and not often difficult to manage, although at times the surgeon's ingenuity is taxed to prevent deformity.

Under all circumstances, the forearm should be flexed, and the hand kept in the semi-prone position. Two *wide* splints should be employed, well padded, broad, and coming down to the roots of the fingers, the surgeon so arranging his pads as to prevent deformity and to neutralize the peculiar tendency of the fracture. When the parts are bandaged too tightly, the bones may be pressed together and consolidation takes place as a whole, with consequent loss of motion, or the two bones may be braced together by some bony isthmus (Fig. 497). Under all circumstances, the fracture should be put up with the hand supinated, the dorsal splint being first applied and then the palmar, the forearm being semi-flexed. When fracture of the radius and ulna takes place above the wrist-joint, the symptoms may simulate those of dislocation; but the greater mobility of the lower ends of the bones, crepitus, and local pain, ought to forbid the error being acted upon.

Fig. 497.



Radius and ulna consolidated after fracture. Prep. 1119^{30}.

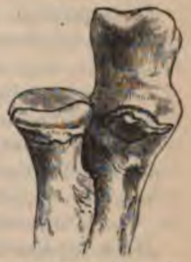
Fracture of the carpal bones can only occur from direct violence, some crushing force being the usual form. It may be difficult to diagnose, as the same force that produced the fracture to a certainty will have injured the soft parts around the bones. Happily, however, the treatment of any severe injury to the wrist should be such as will serve for all; for the application of an anterior splint, as well as cold lotions and absolute rest of the injured part, ought always to be observed in all clear as in doubtful cases, and with these a good result may generally be secured.

Fracture of the metacarpal bones is not rare. It is commonly caused by some blow when fighting or other form of direct violence. It is rarely complicated with any displacement. In young subjects, the head of the bone or epiphysis may be displaced. It should be treated as all fractures, "with brains," the pads and splints being so applied as to fulfil the wants of the individual case. In the majority, a simple pad placed on the palm with an anterior splint may be sufficient. In one case, Malgaigne's plan of placing a thick compress under the head of the bone, and a second over the dorsal projection with two broad splints across the hand may be called for. In another, Sir A. Cooper's, of binding the flexed fingers over a ball, may fulfil the necessary requirements; but, as a rule, an anterior splint and palmar pad carefully adjusted, supplies every want and is sufficient, the surgeon remembering that the palmar surfaces of these metacarpal as well as phalangeal bones are concave.

Fracture of the phalanges is usually compound, although it may be simple and is easily diagnosed and readily treated. A simple anterior splint is all that is required, a dorsal being rarely called for; a piece of wood serving for the purpose, though a thin piece of perforated zinc is preferable. The splint should be fixed with strapping, a coating of the compound tincture of benzoin rendering all firm and immovable.

In compound fracture into the elbow-joint, when the parts are much injured, excision, probably, is the wisest step to adopt, as by it convalescence is hastened, and a good arm with a movable joint, as a rule, given; whereas a recovery by natural processes without operation, will probably end with anchylosis after a tedious process of suppuration. When the injury, however, is not severe and the patient young, excision is not called for, a recovery with a movable joint being possible. I have had several excellent examples of this under my care during the last few years. In aged subjects, however, amputation may be required; and in the one from which the preparation (Fig. 498) was taken, such a step was demanded. The drawing illustrates an uncommon form of accident—comminuted fracture of the head of the radius and fracture of the coronoid process.

Fig. 498.

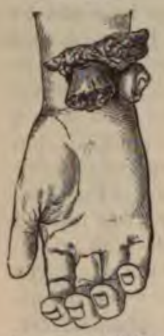


Fracture of the coronoid process and head of radius, produced by a fall upon the elbow; taken from a woman æt. 70

Compound fractures of the arm and forearm ought to be treated upon the same principles as the simple, that is, when the injury is not sufficient to necessitate amputation or excision, the bones should be brought into apposition, and kept there by means of splints interrupted or not, the wounds being covered either by lint soaked in blood, or, by what is better, the compound tincture of benzoin. It may be added, that the injury should indeed be great to necessitate amputation, it being justifiable to incur some extra risk to save the hand.

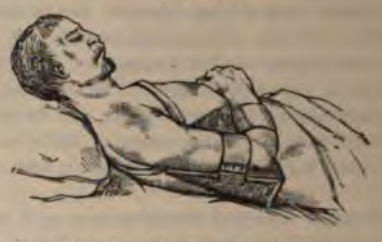
In a severe case of compound comminuted fracture of the humerus caused by the passage of a rifle bullet through the bone in a young man, which came under my care at Guy's, good success attended the immediate sealing of the wound with benzoin, as well as the application of the splint. The man left the hospital in three months with a firmly united bone and a good sound arm. In such a case as that represented in Fig. 499, where displacement of the lower epiphysis of the radius and dislocation of the ulna existed, amputation was demanded.

Fig. 499.



Compound dislocation of ulna and displacement of shaft of radius from its lower epiphysis.

Fig. 500.



Stromeyer's cushion (from Mac Cormac). With straps applied.

I have little to add to what has already been given in the way of treatment of compound fracture of the humerus beyond an allusion to Stromeyer's cushion, which commends itself to attention as much by the eminence of its advocate as by its usefulness. It was introduced to our notice by Mr. William Mac Cormac (Fig. 500).

The cushion may be described as triangular and wedge-shaped. At its thickest end it measures four inches in depth, and from this point gradually thins down for a length of fourteen or fifteen inches. The elbow rests on the thick end, while the thin rests on the side of the chest. The cushion is readily fastened in its place by a tape round the neck and the body; and when this simple apparatus is applied, the arm rests beautifully supported and in excellent position. Whilst lying in bed, nothing beyond the ordinary dressings are required for the wound, and, if the patient has to be transported from one place to another, or is fit to walk about, this can be arranged with the utmost facility, as cushion, arm, and all can be bound by a broad bandage to the body, and thus form an immovable whole. Stromeyer considered this cushion to be "the most valuable appliance he had invented during his life." I have used it for fracture and dislocation of the humerus and shoulder-joint disease, with great advantage, and have adapted straps to it to hold the arm and forearm in position.

Compound dislocation and fracture of the phalangeal joints require a distinct consideration, and the slight constitutional symptoms which such injuries induce, enable the surgeon to treat them on purely local considerations.

To dwell on the importance of the integrity of the hand as a whole, or to adduce arguments to show the necessity of saving as much as possible of the thumb and fingers is unnecessary, since these rules of practice are now acknowledged; yet such have their limit, as anchylosis of some of these joints may prove an impediment rather than an advantage to the free use of the hand, and, while a stiff finger to a man in one business may be most detrimental, in another if bent it may be of service.

With the thumb, however, the above rule may be considered absolute, and an attempt should invariably be made to save the joints and as much as possible of the injured parts; it being often better in compound fractures to leave the bone to granulate than to remove it, for the use which may be made of the stump of a thumb, or of one fixed by anchylosis, can only be appreciated by those who have been fortunate enough to witness such instances.

With the fingers, this rule will not hold so good, since it often happens that the loss of a finger will be found of less inconvenience than a stiff one. In a general point of view, a stiff metacarpo-phalangeal joint to a laboring man is an impediment, while to a gentleman it may be of service, and at the same time preserve the comeliness of the part. A stiff first phalangeal joint will be most prejudicial in some trades, while in others it is of slight importance. A stiff joint between the extreme phalanges is rarely of much moment.

The patient, however, should be consulted by the surgeon in all these cases, and the treatment moulded to the wants of the individual; since a position that may be good for one may be bad for another, and no one position is applicable to all. It is too common to find men applying at London hospitals to have fingers removed that have been saved but fixed at bad angles; the stiff finger being an impediment to the free performance of their trade.

In compound fractures and dislocations of the thumb, loose fragments of bone should be removed and joints excised; as much as possible of the soft parts should be saved, and the wound left to natural processes for repair. To amputate a thumb for injury ought to be a very rare operation. In these injuries to the fingers the same principles of practice should be adopted, although modified by the wants of the individual case. To save a finger, and to amputate it months after on account of some stiffness of joint or malposition is to waste time. When a joint has been opened, and anchylosis must be looked for after a natural recovery, the propriety of making the attempt should be discussed before the practice is decided on, when, if the decision be in favor of a conservative practice, the injured parts should be adjusted and fixed by means of a splint in the most favorable position.

In most subjects, the straight is a forced and inconvenient position, and not that ever assumed by nature, with the hand at rest. The best is the slightly bent, when the thumb and fingers can touch at their tips, or that which the hand naturally assumes when at rest. In exceptional cases, however, exceptional positions may be required. I have for years acted upon this principle, and always with advantage.

The best splint for fingers is a piece of perforated zinc. It is thin, and can be bent to the required curve without trouble, as well as readily fixed on with strapping or lint saturated in tincture of benzoin.

FRACTURES OF THE LOWER EXTREMITY.

Fractures of the pelvis as of the cranium, spine, and thorax, are of importance, inasmuch as the visceral contents are involved, but when no such complication exists, the injury is, comparatively, not dangerous.

Fracture and dislocation of the bones commonly occur together, and may be regarded as alike in a clinical point of view.

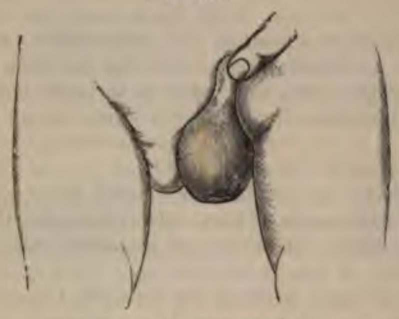
The **anterior portion of the crest of the ilium** is not rarely broken from direct violence, and the accident is not serious. Rest in bed to keep the abdominal muscles quiet, and the application of a pad with strapping, or a broad pelvic belt when displacement exists, are the ordinary surgical means required.

Fracture of the pelvic basin itself is usually the result of some crushing force, the weakest part breaking, such as the rami of the pubes. In other cases, there will be some separation of the pubic bones at the symphysis or other fracture of the brim. In many, the injury will be complicated with some laceration of the urethra. In the case of a female, æt. 30, which I had under care, the bones were displaced on the right side for more than an inch, when a curious deformity resulted; the pelvic bones with the adductor muscles being curved out, leaving a hollow on the inner side of the thigh.

In another, sent to me by Dr. Bennet, of Builth, in a female child, great separation of the pelvic bones was present, the whole pelvic organs having been pressed out of the outlet of the pelvis by the crushing force. The large intestine for about a foot, uterus, bladder, &c., were all in view, the whole perineum having been ruptured. The drawing (Fig. 501) shows the child's condition when I saw her fourteen months after the accident. How the child escaped with life was a mystery, the perineum being gone, the bowels protruding, and the bones of the pelvis widely apart. Such a case is enough to show how great an injury the pelvis may occasionally sustain without causing death.

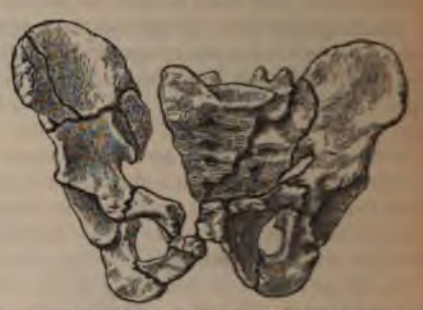
As an example of fractured pelvis, Fig. 502 may be referred to. The greatest care is necessary in examining the subject of a suspected fracture of the pelvis, yet the diagnosis can generally be made from the nature of the force employed, its direction, and the complications that exist. Urethral complication is the most common in the male, and ought to be treated as already described at page 620. As an illustration of the practice there recommended, in June, 1875, a boy, æt. 7, was admitted under my care into Guy's Hospital with fracture of the pubic bones and laceration of the urethra, accompanied with profuse hemorrhage and retention, for which catheterism was ineffectual, and death seemed imminent. I consequently made a free incision into the perineum down to the lacerated urethra upon a grooved staff, and a rapid recovery took place after. Under all circumstances, the utmost quiet must be enforced, for if the surgeon is unable to restore the fractured bones to their normal position, at any rate, he must do nothing to render their displacement greater, or increase the risk of visceral injury. Where support by means of a bandage, strapping, or casing of gutta percha or some other substance gives comfort or seems called for, it should be applied; but, in general, absolute rest, and such treatment as the complication may require, are all that is necessary. In two cases, I have seen obstruction of the iliac artery associated with fracture of the brim of the pelvis; in one, the vessel was so stretched as to cause laceration of its inner and middle coats and obstruction, which was followed by gangrene of the corresponding limb. In the other the obstruction lasted three weeks, when pulsation returned and the patient recovered.

Fig. 501.



Fracture of the pelvis in a child, with separation of pubes, prolapse of rectum and uterus.

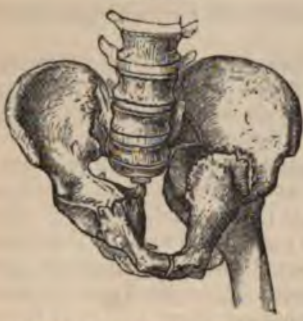
Fig. 502.



Fracture of pelvis. Prep. No. 1134, Guy's Hosp. Mus.

Fracture of the acetabulum, from the head of the femur being driven against the bone has been recorded. Earle, in the nineteenth volume of the 'Med.-Chir. Trans.,' adduced a case in which the pelvis was broken into its three anatomical portions. Sir A. Cooper and Travers have recorded others. Moore, also, in the thirty-fourth volume of the same transactions, has given another with a drawing as figured here (Fig. 503). When the head is driven into the pelvis, as illustrated in the drawing, there will be deformity of the hip, inability to move the limb, with pain in the attempt, and crepitus. Travers believed that acute pain on pressure upon the projecting spine of the pubes, and inability on the part of the patient to maintain the erect posture after pelvic injury, are diagnostic of *fissure of the acetabulum.*

Fig. 503.



Head of femur driven through acetabulum. 'Med. Chir. Trans.,' vol. xxxiv.

A fracture of the *lip of the acetabulum* is probably present in such cases of dislocation of the hip as become displaced again after reduction; the head of the bone, having nothing to restrain it, slipping out of its cup. In these cases, the reduction of the dislocation is usually attended with crepitus followed by re-dislocation on the removal of the extending force. It should be treated by fixed extension as in fracture of the thigh-bone, and some circular pelvic pressure. This accident is more frequently associated with dislocation of the head of the femur backwards than with any other.

Fracture of the sacrum may be regarded clinically as that of the pelvis, but is always the result of direct violence.

FRACTURES OF THE LOWER EXTREMITY.

From hospital statistics these fractures appear to be more common than those of the upper extremity; but, as the majority of cases of fracture of the upper extremity are treated as out-patients, and of which no records are kept, the conclusion is weakened by a fallacy. Mr. Lonsdale, however, tabulated all cases at the Middlesex Hospital for six years, and finding that 516 examples of fracture of the lower extremity took place to 764 of the upper, proved that fractures of the upper extremity are 50 per cent. more frequent than those of the lower.

Fractures of the femur may be divided into those of the *neck or upper end*, of the *shaft*, and of the *lower or condylar end.*

Fracture of the neck or upper end existed in 44 out of 217 consecutive cases admitted into Guy's, or in one-fifth of all cases. It is more frequent in the old than in the young, probably from the impaired nutrition of the bone, the cortex in the aged being always thinner and the cancelli larger. I have, however, seen it in a boy, æt. 12, and a man, æt. 27. Stanley and Hamilton have recorded examples at even an earlier age. In Guy's Museum there is a specimen taken from a child æt. 9. (Prep. 1184.)

When the fracture takes place near the head of the bone it has been called *intra-capsular* (Fig. 507), when near the trochanters, *extra-capsular* (Figs. 504–5)—terms that for practical purposes ought to be relinquished. Both forms may be *impacted*, and in Fig. 508 both are seen together.

The best division of fractures of the neck of the femur seems to be into the *impacted* and *unimpacted*, the old division of intra- and extra-capsular fracture being as unscientific as it is unpracticable.

Fractures of the *base* of the neck are almost always impacted at their origin, and become unimpacted from some dislodgment of the impacted fragments, or comminution of the bone (*vide* Figs. 478, 504, 5).

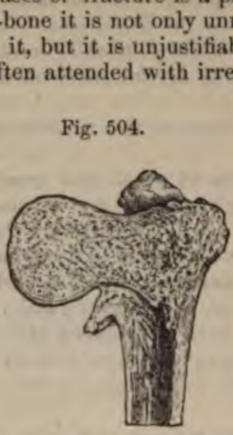
Fractures of the *narrow part* of the neck may be impacted, but more commonly are unimpacted from the first. This form of fracture is more properly called *intracapsular* than any other (Fig. 507).

In rare examples a double impaction of the head and neck of the bone is found (Fig. 508).

Sir A. Cooper recognized this to a degree, though he did not quite see its importance, when, in describing fractures of the upper part of the thigh-bone, he wrote "the fracture is placed at the root of the neck of the thigh-bone, the trochanter is split, and the neck of the bone is received into its cleft. It frequently happens in this injury that the fracture of the neck of the thigh-bone is complicated with an injury of the trochanters, major and minor; the neck of the thigh-bone is forced at times into the cancelli of the major trochanter." To the late Professor R. W. Smith, of Dublin, the thanks of the profession are unquestionably due for having given prominence to this class of cases, and in his valuable work on Fractures in the vicinity of joints, published in 1850, will be found nearly all that is known about the subject.

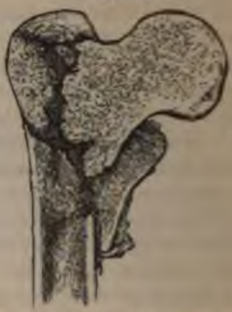
I am fully prepared to endorse his opinions, and agree with him, "that all extra-capsular fractures are, in the first instance, also impacted fractures." I believe, moreover, that many so-called intra-capsular fractures and all mixed forms are primarily of a like kind, and "that it depends principally upon the violence with which the injury has been inflicted whether the neck of the bone shall remain implanted between the trochanters, or whether these processes shall be so completely separated from the shaft of the femur as to allow of the escape of the cervix from the cavity which it had formed in the reticular tissue of the lower fragment. If the force had not been very great the neck of the femur remains wedged in between the trochanters, and one or both of these processes are split off from the shaft; and if the fibrous structures around the neck of the bone and trochanters have not been injured, these broken portions of the trochanters are still held firmly in their places, and the cervix does not become loosened (Fig. 504); but if the force has been considerable, the impulse prolonged, the bone in a state of senile atrophy, or if, as frequently happens, the patient in endeavoring to rise falls a second time, then, under these circumstances, the trochanters are not only broken from the shaft of the femur, but are so far displaced and separated from their connection with the soft parts that the cavity or socket, as it were, into which the superior fragments have been received, is destroyed; the impacted cervix thus set free no longer opposes the ascent of the inferior fragment, and the case then presents the characters of the ordinary extra-capsular fracture with great shortening of the limb." (Fig. 505.) In fact, the ordinary fracture of the base of the neck of the thigh-bone is primarily an impacted fracture, the impacted bones in some cases being loosened by a second fall, in others by excess of violence received in the original accident, and *in too many by the manipulation of the surgeon in his anxiety to make out the presence of a fracture by the detection of crepitus.* Indeed, this seeking for crepitus in cases of fracture is a practice fraught with danger. In fractures of the neck of the thigh-bone it is not only unnecessary because the diagnosis of the case can be made out without it, but it is unjustifiable, as the attempt to find it in every case of impacted fracture is often attended with irreparable mischief.

Fig. 504.



Impacted fracture of the neck of the thigh-bone, from the museum of my father, the late Mr. T. E. Bryant. Prep. Guy's Mus., 1187^{35}.

Fig. 505.



Comminuted fracture of the upper part of the thigh-bone, from the neck being driven into the shaft. Prep. 1194, Guy's Mus.

The **diagnosis** of an impacted fracture is a point of considerable importance, since it is not to be disputed that the recovery or degree of lameness of many a patient depends upon a correct appreciation of the value of such symptoms as usually exist in this variety of fracture, and that, too, in a very critical period of the case. Should an error in diagnosis be made, and the case being one of impacted fracture be overlooked, violent manipulative efforts will probably be made to reduce the supposed dislocation or to set the supposed fracture; or, what is equally probable, to decide the question between the presence of the two by the detection or non-detection of crepitus. As a consequence of this violence, the impacted bones to a certainty will be loosened, if not worse disturbed, and the case will be changed from one in which the bones were placed favorably for union and recovery, into another in which a very different set of circumstances has to be encountered and a less favorable prognosis has to be given.

Fig. 505a.

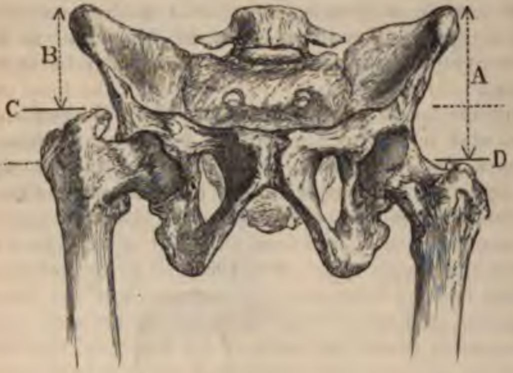


Figure showing how the trochanter of the fractured bone is drawn upwards nearer the anterior superior spine of the ilium. A, Normal length of base of ilio-femoral triangle (Fig. 506); B, Shortened base of ilio-femoral triangle; C, Horizontal level of fractured bone; D, Horizontal level of sound bone.

Happily, however, the diagnosis of these cases is not difficult, and the symptoms that indicate the presence of an impacted or non-impacted fracture are fairly characteristic. They may be given as follows:—A blow or *fall upon the trochanter*, followed by more or less complete *loss of power* in the limb. a variable degree of *shortening*, a *fixed*, *everted*, *inverted*, or *straight* position of the foot, which moderate extension will *not* rectify, and when the impaction is great, an approximation of the great trochanter to the median line of the body (Fig. 505a). The head of the bone will rotate in the acetabulum, and the trochanter with it, the rotation, however, of the trochanter taking place through an arc of a circle of which the head of the bone is the centre, instead of upon the axis of the shaft as in detached fracture of the neck. There will be indistinct or no crepitus. Local pain will always be felt on pressure behind the trochanter, and local thickening within a few days of the accident.

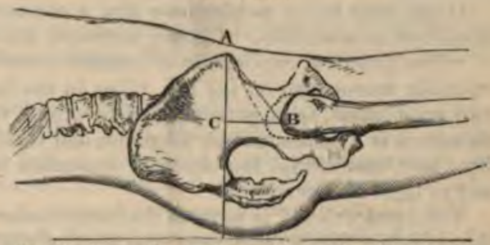
When from the direction of the force applied to the trochanter the *posterior* wall of the neck is driven into the inter-trochanteric line, the limb will be rotated outwards and the foot *everted;* and, when the *anterior* wall is driven into the bone, there will be *inversion* of the limb. The former form of accident is far more common than the latter, on account of the greater thinness of the posterior wall.

To make out the existence of shortening of the neck of the thigh-bone and its amount, the following "test line" may be employed. I, as well as my dressers, have used it for many years, and found it of great value; indeed, as a proof of its use, I may add that twenty-four consecutive cases of fracture of the neck of the thigh-bone, admitted into my wards to the end of 1877 (the average age of the patients being 74), left the hospital with union of the broken bones and useful limbs. The diagnosis of all these cases had been made by means of the test line I now describe, and with the gentlest manipulation. ('Lancet,' January 22, 1876.)

For purposes of demonstration I have described it as the base of the ilio-femoral triangle (C B, Fig. 506), the two sides of the triangle being made up of two lines drawn from the anterior superior spinous process of the ilium, one of them, A C, being vertical, and traversing the outside of the hip to the horizontal plane of the body; and the second, A B, impinging on the tip of the trochanter major and corresponding in the normal condition of the hip-joint to the anterior half of Nélaton's test line for dislocation of the head of the femur backwards.

The "test line" C B for fracture or shortening of the neck, joins the two at *right angles* to the vertical line, and extends from it to the trochanter.

Fig. 506.



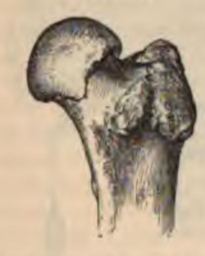
The ilio-femoral rectangle A C B. C B test line for fracture or shortening of the neck of the thigh-bone.

Any shortening of this line, on comparing it with the same taken on the uninjured side, indicates with precision a shortening of the neck of the thigh-bone; and, when the shortening has followed at once upon an injury; fracture of the neck of the thigh-bone, impacted or otherwise, is certain. Compared with this line, all other measurements are uncertain. By its use, manipulations of the injured limb are often rendered unnecessary.

For practical purposes, the vertical line A C and the test line C B are alone required. To compare the two sides of the body it is necessary to see that the pelvis is straight.

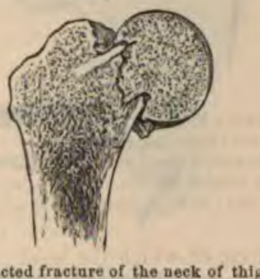
The symptoms thus described, taken as a whole, may be looked upon as pathognomonic of an impactured fracture; for, although there are other injuries to the hip-joint which may give rise separately to many of the symptoms detailed, there are none in which all or most are found combined. There is no injury to the hip-joint in which the head of the femur rests and can be made to rotate in the acetabulum and in which *immediate shortening* is ever found, with the exception of a fracture; and there is no form of fracture that occurs under like circumstances, with the exception of the impacted, that is not accompanied by crepitus that can be readily detected, with complete eversion of the foot, marked shortening, and loss of power over the limb.

Fig. 507.



Intra-capsular fracture of the neck of femur. Case of the late Mr. T. E. Bryant. Prep. 1187^{80}, Guy's Mus.

Fig. 508.



Doubly impacted fracture of the neck of thigh-bone

These points are well brought out in a paper in the 'Med. Times' of 1869, in which I gave a careful analysis of fourteen cases.

When sudden increase in the amount of shortening takes place some days after an injury to the hip, the separation of the impacted bones and the drawing up of the lower

fragment should be suspected, and, when some gradual shorten
absorption of the injured neck of bone.

The eversion of the limb as found in the non-impactured fra
weight of the broken limb, aided by the action of the powerfu
sibly of the adductor muscles. The position of the limb
whether slightly everted, straight, or inverted, is determined
anterior or posterior wall of the neck, and by the fact, that th
impaction in the position in which it existed at the time of th

In non-impacted fracture of the narrow end of the neck or t
there is usually more shortening than in the fracture of the ba
ing in both of these cases upon the amount of separation of t
broken bone. In the former, crepitus is also less distinct.
shortening will be made to disappear by extension, whilst in t
varieties, no such effect will be produced by ordinary force.

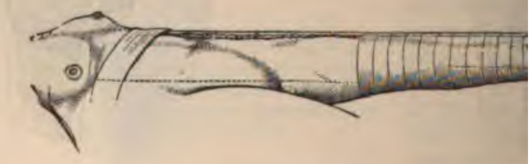
It can only be by carelessness that a contused hip is mistak
impacted or otherwise. I have, however, known this error to

"The practical importance of readily identifying this fractu
valuable monograph on the hip, "lies in the fact that its progr
and good union, is in general more favorable than that of the
though it is a comparatively common and disabling accident, i
ity; and, lastly, that the object of extension in its treatment
not to draw it down."

TREATMENT.—If it were as distinctly understood as it sho
practitioners that a fracture of the neck of the thigh-bone can
ing for crepitus, that all but the gentlest manipulation of an in
injurious, and that any attempt to elongate the limb by forcibl
rotate it with the view of restoring it to its natural position i
breaking up of the impacted bones and consequently by irrepa
of these cases would be as satisfactory in its results as it is si
be occupied with fewer cripples. Every case of fracture of
pacted or non-impacted, intra- or extra-capsular, in the young,
be treated as if repair and union were sure to take place if th
in apposition; and, in the large proportion of cases, the hopes
disappointed. In the impacted fractures, union ought to be lo
ments are left alone and not loosened by a careless or too curi
purely intra-capsular fracture, union may take place, osseous
more. In a few there will be none, owing to total separation o
its attachments, or to the feeble power or age of the patient,
ment receives too little nourishment to allow of sufficient repar
out, or because the fractured bones have not been kept suffici
tion. Under these circumstances the head of the femur will
with its broken surface smoothed into a cup-shaped cavity, wh
broken neck of the femur plays as in a false joint.

In the impacted fractures, the limb ought simply to be kep
attained by means of the double splint.

FIG. 509.

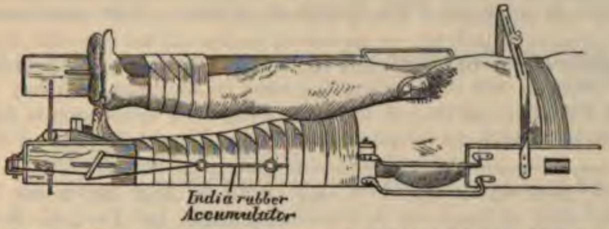


Long splint, with weights for extension in fracture of the neck

In the non-impacted, extension is to be more thoroughly
brought down to a level with its fellow, and maintained there
splints and the use of weights (Fig. 509); or by what is prefe

as applied with the double splint (Fig. 510), in which both limbs are kept parallel, abduction or adduction of the limb prevented and extension maintained, no pressure being applied over the trochanters. With this splint no perineal band is required if the foot of the bed is raised two or three inches. It is as valuable for fracture of the thigh-bone as for disease of the hip-joint.

Fig. 510.



Double splint for fracture of the shaft or neck of the thigh-bone and hip-disease.

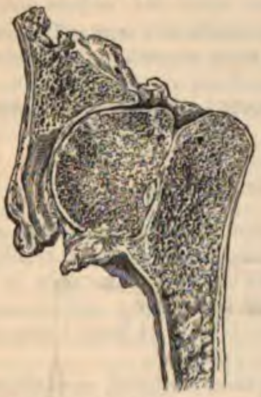
Sir A. Cooper's plan of placing the patient on a double inclined plane has few advantages when union is to be looked for, and even the broad, well-padded belt which he applied round the pelvis in order to keep the broken fragments closely together cannot be recommended; still, where the long splint cannot be worn the inclined plane may be substituted.

In the impacted fracture no perineal pad is wanted, as no extension is required. In the non-impacted, where it is used, care must be observed that it is well applied and well padded, particularly in aged subjects; an india-rubber perineal tubular band being better than a leather one.

When the necessary confinement to the supine position cannot be tolerated and bed-sores appear, it may be necessary to give up the long splint, and under these circumstances, it is wise to fix the hip, pelvis, and thigh, in some strong immovable casing similar to that employed in the hip disease (Fig. 555), the limb being kept extended by means of weights attached to the foot during the setting of the material. The casing may be of leather, felt, perforated zinc, or flannel, with starch, or gum and chalk.

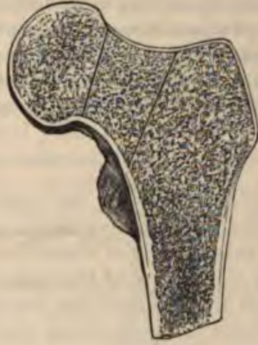
To allow the patient to get up without any apparatus is not only to give up all hope of a cure by union, but adds to the local irritation, as the broken fragments will grate against one another and irritate the soft parts around, often causing severe local and constitutional disturbance. Under all circumstances, however, immobility of the broken bone is to be insured.

Fig. 511.



Fracture of the neck of the thigh-bone within the capsule, repair of fracture by means of bone, fibrous tissue and fibro-cartilage; absorption of the neck of the bone. Prep. removed from woman, æt. 60, who had received the injury five years before.

Fig. 512.



Femur of the opposite side, showing the amount of bone absorbed.

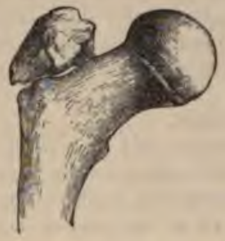
Interstitial absorption of the neck of the bone is sometimes met with after fracture, and in Fig. 511 the fact is well illustrated, the neck of the bone having almost entirely disappeared, as will be seen at once on comparing a section of the injured bone with that of the uninjured, from the same subject (Fig. 512). It is said also to take place after a contusion without any fracture in osteo-arthritis; how far it may occur otherwise is an open question. My own impression is that in all such cases some fracture existed, though it is difficult to prove the truth of such an opinion. The question requires further elucidation.

Fractures through the trochanter occasionally occur. Sir A. Cooper describes them as oblique fractures not implicating the neck of the bone, and can be made out by the immobility of the lower portion of the bone whilst the upper part is fixed, and by the other signs of fracture, such as crepitus, &c. They should be treated like fractures of the neck.

Separation of the epiphysis of the head of the bone has been described. South has recorded such cases in his 'Chelius's Surgery,' and Post, of New York, in the 'New York Journal,' vol. iii, but no preparation exists to demonstrate the fact. It is, doubtless, possible in the young, and would be known by some such symptoms as those of fracture of the neck, crepitus being exchanged for what South calls a "distinct dummy sensation" on rotating and extending the limb. As a consequence of disease, it will be described in a later chapter.

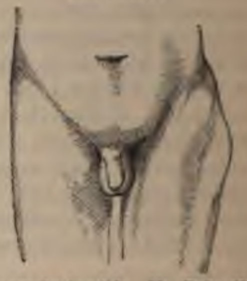
Separation of the epiphysis of the trochanter major is a more definite accident, and doubtless has occurred. Sir A. Cooper recorded a case which Mr. Aston Key had observed, and the diagnosis was verified after death. In it, the detatched fragment, however, was not displaced but held in position by means of its fibrous and tendinous coverings; and was the result of direct local violence; abduction of the limb caused great pain, but all other movements were allowed. The preparation exists in the Guy's Museum, 1195, and is figured below (Fig. 513). A like case occurred in the practice of the late Mr. Poland, at Guy's, in 1871, which through his kindness I saw. It occurred in a boy, æt. 12, from a direct blow, and was characterized by a projection and thickening of the trochanter (Fig. 514). Similar instances have also been published by Dr. Roddick, of Montreal ('Canada Med. and Surg. Journal,' Nov. 1875), and Mr. McCarthy ('Path. Trans.,' 1874).

Fig. 513.



Mr. Aston Key's case. Prep. 1195, Guy's Mus.

Fig. 514.



Appearance during life. Mr. Poland's case.

Fracture of the epiphysis of the major trochanter.

Fracture of the Shaft of the Femur.

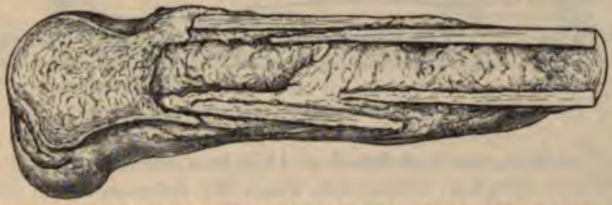
This may take place in any part, but is more common in the centre than elsewhere, and, as a consequence, of indirect violence; it may occur, however, as a result of direct force, and more rarely of muscular action. From this cause I have seen it from the swinging of the limb over the side of a cart in the act of descending, and, in an epileptic patient, from the spasm of the muscles, with the patient in bed. I have known it also to take place from the same cause when cancer of the bone existed.

The fracture may be *transverse*, *oblique* in any direction, *dentated*, *comminuted* or *impacted*, the nature of the force and its direction determining these points; a sharp blow is likely to be followed by a transverse fracture; a crushing force by a comminuted one; an indirect fracture probably will be oblique, according to the natural bend in the lower part of the limb. In the middle of the bone, a lateral obliquity is the most common, in the lower third, an obliquity from behind forwards. Fractures may also be double in the same bone or compound. In the case illustrated (Fig. 515) the fracture was impacted, the upper fragment having been forced into the hollow of the lower, which it has split.

It occurred in a patient under my care in 1876, æt. 83, from a fall down an area upon his knee. The man died on the 29th day from kidney disease. ('Path. Soc. Trans.,' vol. 29, 1878.)

The displacement that takes place turns much upon the line of the obliquity and the position of the fracture. In fracture below the lesser trochanter, the upper fragment is prone to be drawn forward by the action or the psoas and iliacus muscles, and outward by the external rotators. In fractures above the condyles, the lower fragment is apt to be drawn backward by the unantagonized action of the gastrocnemii muscles. In fractures of the centre of the shaft, the deformity depends on the line of obliquity. Rotation outwards of the lower fragment is found in nearly every case.

Fig. 515.



Impacted fracture of the shaft of the femur, produced by a fall upon the knee in a man, aged 83.

There is usually no difficulty in diagnosing a fracture of the shaft, the following symptoms being usually present: A fall or injury, followed by loss of power in the limb; shortening, which extension can rectify; deformity, probably angular; extra mobility of the lower part of the injured limb; crepitus; and probably the projection of one end of a fragment with eversion of the foot. When the fracture is transverse, the shortening will rarely be marked; when it is oblique, the direction of the angular deformity often indicates the line of the obliquity.

In young children where the fracture is incomplete, shortening with bowing of the limb after an accident, and an indistinct sensation of yielding on manipulation, with or without a peculiar crackling sensation, indicate the nature of the accident.

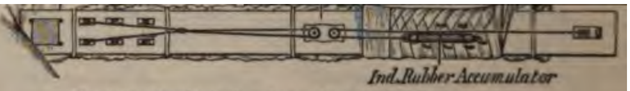
Treatment.—The fragments having been carefully adjusted by means of extension and gentle manipulation, the mechanical treatment of these fractures consists in the maintenance of extension by means of some applied force and the complete rest of the coapted bones; gentle compression of the affected part being sometimes beneficial. To assist the surgeon towards these ends, some anæsthetic may be used if the pain be severe and it is impossible by other means to keep the patient at rest, and any spasmodic action of the muscles interferes with the surgeon's aims.

The means adopted for these ends vary considerably, according to the fancy of the surgeon and the fashion of the school. Thus, in hospitals where the Scotch influence is great, Liston's long splint is the usual one employed, which should extend well up into the axilla, and several inches below the foot (Fig. 509, without foot-piece). It ought to be well padded and supplied with a soft perineal band, such as a leather strap, or a piece of india-rubber tubing. The ankle and instep should be well protected from pressure by cotton-wool, and the retaining bandage applied with equal pressure.

At Guy's, where the long splint has been for years employed, Desault's splint, with a foot-piece (Fig. 528), and the addition of a cross-bar for steadiness has been more generally preferred, although within the last few years it has given way to the double one (Figs. 510, 553). The splint may be of wood or metal, and made with a slide so as to be adjusted to different patients.

In fractures of the upper third, where the upper fragment is apt to tilt forward and be rotated outwards, the double inclined plane is often of great value. It should be employed, however, only when the long splint fails to fulfil the objects the surgeon has in view. It is daily dropping out of use.

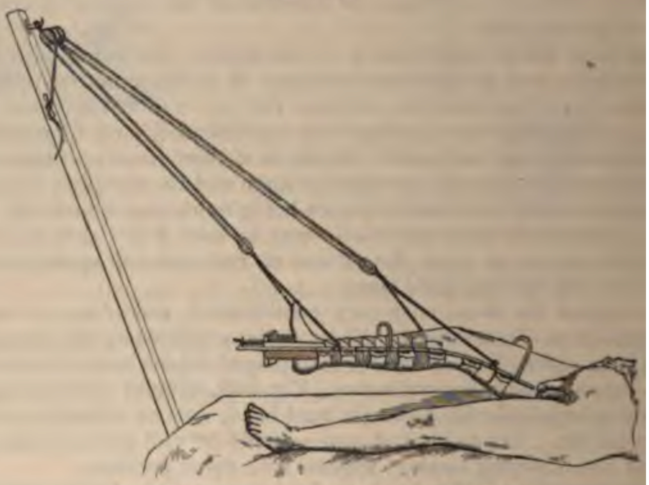
Gurdon Buck's method of applying extension to the limb by means of weights has found great favor of late years, and is doubtless very good and simple, the counter-extending force being applied by means of a perineal band of india-rubber tubing fastened to the head of the bedstead or splint, while the limb is steadied by means of long sand-bags applied laterally, or short thigh splints. This plan, however, has the disadvantage of not preserving sufficient immobility of the broken bones, and ought, therefore, only to be employed in conjunction with the long splint.



Mr. Cripps' splint, showing value of elastic suspension.

A splint full of promise was introduced in 1875 into practice at Guy's
517) from the Marine Hospital, Greenwich, where Mr. Johnson Smith info
employed it in thirty cases since 1870 with good results. It is a modi
invented by Dr. J. T. Hodgen, of St. Louis, U. S. ('Treat. on Mil. Su
Hamilton, 1865, p. 411), for gunshot fractures, and is made of galvanized
2). In it the injured limb may be supported on a piece of flannel, which
iron rod, or, upon pieces of bandage. Extension is kept up by means of
attaching the foot of the injured limb to the lower cross-bar of the splint, a
suspending cords and pulleys. The counter-extension is maintained by the
limb above the fracture and weight of the body.

Fig. 517.



Dr. J. Hodgen's suspension splint, as used at Guy's.

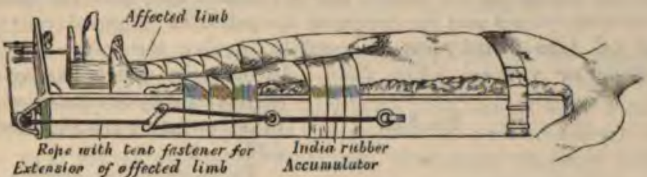
The splint as seen in Fig. 517 is most comfortable to the patient

Hodgen's splint should not be confounded with Nathan Smith's, which is made of wire applied to the *anterior surface* of the fractured limb, which is suspended to it by rollers (Fig. 534).

When the fracture is compound, an interrupted splint may be employed. In addition to the long splint, short additional splints applied in front, or the inner side of, or behind the thigh as the want of the individual case may suggest, are of great value to insure greater steadiness of the broken bone. In no case should the seat of fracture be covered in. The bandage should stop below, and, if necessary, recommence above it. To prevent the bandage slipping after it has been applied, it is a good plan to give it one coating of paste or glue.

Many modifications of these means might be mentioned. Thus, Paget has very generally employed Busk's long splint, in which a joint exists opposite the hip, which enables the patient, after union has taken place, to sit up without affecting the thigh-bone. Mr. C. de Morgan, of the Middlesex Hospital, applies the extension to the fractured limb by means of a force carried from the foot through a pedal cross-bar to a long splint applied to the opposite one (Fig. 518). This splint is good for fracture as well as for disease or for excision of the hip-joint. Sir W. Fergusson was wont to apply his counter-extension from a strong stay of jean, carefully fitted to the upper third of the opposite thigh, from which a band extended in front and behind to the upper end of the splint, thus doing away with the perineal pad.

Fig. 518.



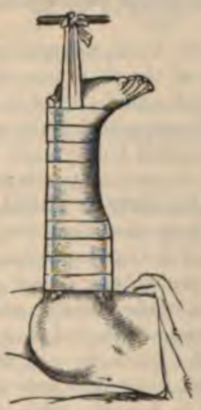
Mr. Campbell de Morgan's splint, with elastic extension.

During the application of the long splint, steady traction should be maintained on the injured limb by a competent assistant. When muscular spasm is severe, some surgeons have advised temporary pressure on the femoral artery in the groin. It is said to stop the spasm in all cases, and whenever I have tried it, it answered well.

In infants and children under three years of age fractures of the thigh are treated with difficulty, for any immovable apparatus is constantly dirtied from urine, feces, &c., and requires to be changed, and the good that would otherwise be experienced is thus neutralized. On this account Paget and Callender have treated, within the last few years, many cases of fracture of the thigh in children, without splints, all apparatus being dispensed with, "the child being laid on a firm bed, with the broken limb, after setting it, bent at the hip and knee and laid on its outer side." ('St. Barth. Hosp. Rep.,' 1867.) I do not recommend this practice, but would advise instead that the injured limb of the child, together with the sound one, be flexed at a right angle with the pelvis, fixed by some light splint and hoisted upwards to a cradle, hook, or bar above the bed (Fig. 519). By these means, the weight of the body acts as a constant counter-extending force, the child can be well looked to for purposes of cleanliness, and a good result may be expected. At Guy's, we have had excellent results from this practice.

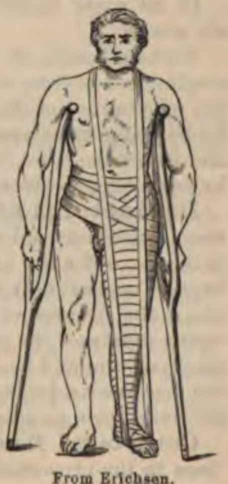
Splints of gutta percha, felt, or leather may be used with the weights when they can be applied; some immovable apparatus being adjusted after the second week; indeed, in some cases this immovable apparatus may be

Fig. 519.



Fracture of the femur in a child treated by vertical extension.

Fig. 520.



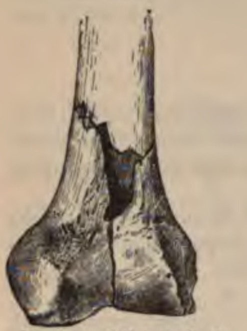
From Erichsen.

applied at once, care being taken that the limb is kept well extended during its application and setting. The Bavarian flannel splint is the best (Fig. 479).

In adults, also, after the fourth week, this same immovable apparatus may be employed with advantage, the patient gaining greater freedom. Some surgeons think so well of this plan as to advise its use in fracture of the thigh from the very first. Erichsen, its ablest advocate, says ('Science and Art of Surgery,' p. 225), "The starched bandage may be employed in most cases. The limb should be evenly and thickly enveloped in a layer of cotton wadding; a long piece of strong paste-board about four inches wide soaked in starch must next be applied to the posterior part of the limb from the nates to the heel. If the patient be very muscular and the thigh large, this must be strengthened, especially at its upper part, by having slips of bandage pasted upon it; two narrower strips of pasteboard are now placed one along each side of the limb, from the hip to the ankle, and another shorter piece on the forepart of the thigh. A double layer of starched bandage should now be applied over the whole with a strong and well-starched spica (Fig. 520); it should be cut up and trimmed on the second or third day and then reapplied." With such an apparatus, Erichsen has treated many fractured thighs, both in adults and children, without confinement to bed for more than three or four days, and without the slightest shortening or deformity being left. The points to be especially attended to are, that the back splint be very strong at the upper part especially, and that the spica be well and firmly applied so that the hip and the whole of the pelvis be immovably fixed.

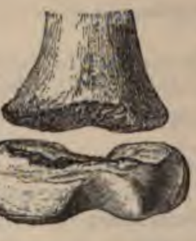
Fractures of the condyles necessarily involve the joint, and these may be transverse, oblique or vertical (Fig. 521). In subjects under twenty-one *the lower epiphysis may be separated from the shaft*, thus simulating a transverse fracture (Fig. 522).

FIG. 521.



Fracture of the shaft of the femur, with longitudinal fissure through the condyles into the knee-joint. Prep. 1200, Guy's Mus.

FIG. 522.



Separation of the epiphysis. Prep. 1210^{43}, (Guy's Mus.)

These cases are serious on account of the joint complication, as some stiffness of the joint generally, but not always, follows; this result depending upon the amount of inflammatory action that takes place after the injury. When the head of the tibia is fractured into the joint, the same observations are applicable. In these cases the posterior splint, as suggested by MacIntyre (Fig. 533), is probably the best, the knee being slightly flexed. When joint complication exists, the application of ice or, probably, some leeches may be required.

In exceptional instances, the upper fragment of bone is driven into the lower, thereby giving rise to an impacted fracture. These cases, like other impacted fractures, generally do well by simple rest.

In all cases involving joints passive motion should be allowed at the end of five or six weeks.

Nathan Smith, of New York, advocates the use of an anterior splint composed of a single piece of iron wire of the thickness of a No. 11 catheter, which is carefully bent to the inequalities of the limb and fastened to it by means of strapping and bandages, the limbs being subsequently suspended to the ceiling by a cord connected with the wire above and below the knee, extension being made through this cord, and the counter-extension by so raising the foot of the bed as to tilt the body towards its head (Fig. 534.)

In fractures of the lower third above the condyles, where the gastrocnemii muscles tend to draw the lower fragment backward into the popliteal space, some surgeons prefer the use of the inclined plane, and, where the bones cannot be otherwise kept in apposition it is, probably, a sound practice. But what I believe to be a better one is the division of the tendo Achillis and the use of the long double splint. This operation paralyzes the gastrocnemii, and thus allows the surgeon to bring the bones into a good position and to deal with them as with an ordinary fracture. I have taught this for the last twelve years, but have had only one opportunity of testing its value. It has, however, been practised in America with success.

Compound fractures of the thigh.—These are desperate accidents, and take lace in the proportion of one to every six or seven cases of fracture of the femur, and when they occur, half the patients die. They should be treated where possible on conservative principles, and amputation should only be performed when the soft parts, with the vessels and nerves, are so injured as to forbid any reasonable hope of recovery. Conservative practice should have full scope in young subjects especially, and when any doubt upon the necessity of amputation exists, the surgeon had better decide upon trying to save the limb, although in the aged an opposite practice should be adopted.

Army surgeons, however, advise the propriety of practising conservatism for gunshot fractures in the upper third of the thigh, and amputation for all fractures of the middle and lower thirds; the nature of gunshot injuries to those parts precluding all hope of a natural recovery. All modern army surgeons, English, American, French, and German, agree upon this point and endorse Dupuytren's, Hennen's, Larrey's, and Guthrie's opinion, that in gunshot wounds of the thigh, "in rejecting amputation we lose more lives than we save limbs," and "that in the exceptional cases which result in consolidation the condition of the limb is not encouraging."

Amputation of the thigh for compound fracture is most fatal, two out of three dying. In the upper third of the thigh, the mortality is still greater.

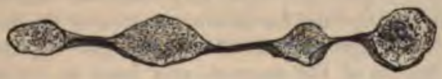
It is from this fact alone that army surgeons have advised the conservative treatment of compound fractures of the upper part of the femur, and Mr. Erichsen has been led to assert, that amputation in the upper third of the thigh for compound fracture is an unjustifiable operation.

When amputation is not at once called for, the wound should be thoroughly cleansed and all foreign bodies with loose fragments of bone removed; the projecting portions of bone should be excised, bleeding arrested, and the wound sealed with blood or the compound tincture of benzoin, a splint should be applied at once, moderate extension employed, and the case treated on general principles, while some surgeons would inject into the wound a solution of carbolic acid (1 in 20), and under the carbolic spray, dress it in the so-called antiseptic method.

FRACTURES OF THE PATELLA.

These are usually transverse from a sudden action of the quadriceps femoris, under a violent effort to prevent the body falling backwards, the knee being at the time partially bent. Such fractures are met with chiefly in the centre of the bone, though they may be above or below it. "If the fracture is very low down probably the knee was but little bent, and thus the greater part of the bone still rested on the condyles." (Hutchinson, 'Med.-Chir. Trans.,' 1869.) In some cases, both patellæ are broken, together or consecutively; in rarer instances, the same patella may be broken more than once. I have had such a case in a man in whom one patella had been broken twice and the other three times; and, in the Guy's Museum, there is a preparation (Fig. 523) from my father's museum, in which the bone had been broken transversely into four fragments, probably from different injuries or from some direct force, each fragment having a ligamentous union.

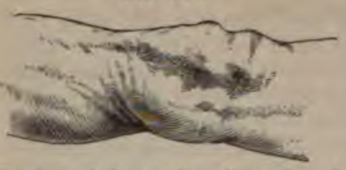
FIG. 523.



Multiple fracture of patella. Prep. 1212^{20}.

These transverse fractures are at times, although rarely, the result of direct violence. The French and American surgeons believe them to be so very frequently. Direct violence to the patella, however, is more commonly followed by what is called a starred or vertical than a transverse fracture, and in these cases, there is rarely much separation of the fragments; in the transverse, the separation is sometimes very great, this fact depending upon the amount of muscular action at the time of fracture. This separation is greatly increased by the effusion that is so apt to take place into the knee-joint, as well as by flexing the leg, both before union has taken place and for many months subsequently, and from a yielding of the ligamentous union. This separation is very frequently an inch, but often more. Sir A. Cooper records a case in which five inches existed. In Fig. 524, the separation is well shown.

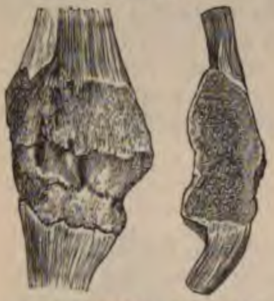
FIG. 524.



Fracture of the patella. Separation of fragments.

The **diagnosis** of the transverse fracture is rarely difficult, the nature of the violence, the sudden loss of power of the limb, the distinct separation of the fragments, and the bulging of the synovial sac between the divided portions of bone, being characteristic. In the *starred* fracture the different pieces of bone may be made out. In the *vertical*, the diagnosis may be more difficult, and can only be made out by manipulation. In exceptional cases where either the ligamentum patellæ or the tendon of the extensors above the patella is broken, some difficulty may be felt, but such accidents are very rare. When the transverse fracture is little more than a fissure, no separation will be found, the amount of separation being determined by the extent of laceration of the fibrous and tendinous coverings of the bone. When the laceration is partial and the separation slight, there is a better hope of a bony or close union than when the laceration is complete and the separation great, and it should be known, that union by bone may take place although probably but seldom; that union by strong ligament, with about half an inch to an inch of separation, is more common; but that non-union is not rare. William Adams, in the 'Path. Trans.,' vol. xiii, informs us that, out of thirty-one specimens he examined, fifteen were examples of ununited fracture, twelve of true ligamentous union, and four doubtful. In the ununited the separation was very great, in the ligamentous, it was rarely beyond an inch and a half. In the ununited the separated fragments were only connected with each other by a single layer of fibrous tissue.

FIG. 525.



Anterior surface. Vertical section. Fracture of patella united by bone. Taken from my father's museum.

That bone union takes place is now generally recognized. In Prep. 1211^{75}, Guy's Museum (Fig. 525), the fact is well exemplified. The specimen has been fully described with remarks, by the late Mr. W. King, in the 'Guy's Hosp. Rep.,' series i, vol. vi.

In the starred or vertical fractures osseous union is generally secured, these cases being rarely attended with complete laceration of the periosteal or fibrous covering of the bone.

TREATMENT.—In all cases, as well as in every form of fractured patella, a long well-padded posterior splint with a foot-piece extending from the tuberosity of the ischium to the foot should at once be adjusted, the knee-joint being left uncovered by the bandage. To the knee-joint, a bag of ice or cold lotion should be applied, for, as a direct consequence of the accident, blood is very apt to be effused, and as a secondary effect, synovial inflammation with effusion is almost sure to ensue.

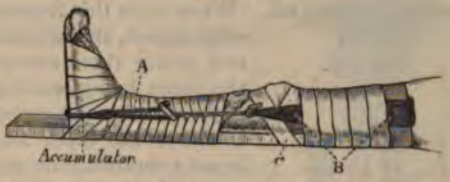
It has generally been the custom to raise the heel with a view to destroy the action of the extensor muscles, but it is now more generally believed that no good is derived from such a measure; as a consequence the horizontal position of the limb is usually employed, the body being raised. The fragments should be brought together at the same time as much as possible by the fingers of the surgeon, and later on by some apparatus. To do so, however, before the joint itself has recovered from the effects of the injury, while blood exists to any extent, or the synovial capsule is distended with inflammatory effusion, is not wise; since any attempt to draw the bones together under these circumstances, can only result in tilting forward the surfaces that are required to be brought into apposition, with no good effect.

For a few days, therefore, until all inflammatory action has subsided, the surgeon should rest satisfied by simply pressing the parts together with his fingers, and when this result has been secured, the two portions may be drawn together by means of strips of plaster diagonally applied, of india-rubber bands covered with washleather attached to hooks which have been inserted at intervals of an inch on either side of the splint, or, what is better, by means of elastic compression, as shown in Fig. 526.

Malgaigne's hooks, which are composed of four claws drawn together by a screw, have been much employed, and are doubtless effectual, but from the fact that they penetrate the soft parts and painfully and forcibly draw the broken fragments together they are objectionable. Good results have, however, been reported from their use.

As soon as all inflammatory action of the joint has subsided and the bones are fairly in position, such an immovable apparatus as the flannel Bavarian splint may be applied, the patella being left exposed or not as the surgeon may think fit. When the bone is bandaged over, care must be taken not to press upon it, as I have known secondary suppuration with necrosis, and joint complication of a serious nature thus ensue. Erichsen uses, as a rule, the starch bandage, and speaks highly of it. He applies it over a pad fixed above the fractured bone, with a figure-of-8 bandage. Whatever apparatus is employed, it should be kept on for five or six weeks at least, and when removed, some light leather or felt casing should be substituted. To allow the patient to flex the limb under three months is hazardous, for the united ligament is sure to be stretched and elongated, and the limb weakened. A good leather knee-cap should permanently be worn after this accident.

Fig. 526.



Splint for fracture of the patella with elastic compression.

A. Cord with tent fastener to regulate extension.
B. Band or strapping bound to thigh.

With the confidence rightly or wrongly engendered by what is known as the antiseptic system, surgeons have been led to cut down upon a fractured patella and to unite the fractured fragments of bone by sutures; and, although in the case or cases in which this practice has been employed, it is a pleasure to record that no bad results followed, yet the practice cannot be recommended but rather condemned.

In examples of neglected cases of fracture where a great separation of the fragments exists and the knee is consequently so weak as to be useless, such an operation may be justifiable, but, under other circumstances, I cannot, as a teacher, regard it otherwise than as a rash and hazardous proceeding.

Compound fractures of the patella.—These are grave accidents, one-fourth of the cases dying. Poland, in an able paper read before the Med. and Chir. Society, 1870, gave an analysis of 85 such cases, and clearly proved that in all cases we should attempt to save the limb, and adopt the ordinary treatment as for simple fractures of the patella. To this end the wound should be well washed with iodine water or carbolic acid lotion, and accurately closed by sutures, and inflammation subdued by the constant application of ice. If suppuration sets in, free incisions should be made into the joint, and amputation resorted to only, when the powers of the patient fail to repair the injured joint. Detached fragments of bone should, however, be removed at once.

Out of the 85 cases collected by Poland, there were 20 deaths and 65 recoveries; in 31 of these there was more or less complete anchylosis of the joint; 20 recovered with movement, 4 were resected, and 5 amputated. The joint suppurated in 43 out of the 65 cases of recovery, and in all the fatal cases.

FRACTURES OF THE LEG.

These are about twice as frequent as those of the thigh. At Guy's, 1090 cases were admitted in six years against 541 of the thigh, and of these 202, or one-fifth, were compound. Of the simple cases, not 1 per cent. died from all causes; and of the compound, 27 per cent. succumbed.

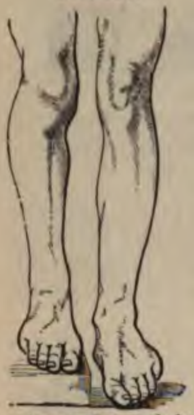
Both bones, as a rule, are fractured; the fibula alone being broken in about one case in six, and the tibia in about one in seven. Lonsdale's statistics indicate these points. These fractures are more commonly met with in adult than in child life.

In fractures of both bones, those of the upper half are usually the result of direct violence, fractures of the lower half of indirect, such as the twisting of the foot or leg from a fall or jump.

In fractures of the tibia alone, the line of fracture is frequently transverse, and from this cause there is sometimes difficulty in making the diagnosis; the nearer the fracture to the knee the more transverse being the line. These fractures arise chiefly from direct violence. They may so unite as to leave no external trace of injury; indeed, they may be attended with so little displacement that the line of the bone is never broken. I have seen more than one patient walk upon the fractured limb directly after the accident, and in one case, the man went up a whole flight of stairs to his ward with but a slight limp. In another, under care in 1874, a woman with a fractured tibia and fibula went about for a week. In a medico-legal point of view, these facts are important. When the shaft has been separated at its upper epiphysis, some arrest of growth may take place; and such a result is illustrated in Fig. 527.

Fracture of the fibula is more common than that of the tibia, particularly in its lower third, and I believe in many examples of what are called bad sprains, a fracture exists. In the upper two-thirds, the fracture is usually caused by direct violence; in the lower third by indirect, such as a lateral twist of the foot. As often as not it is associated with a forcible eversion of the foot. With pedal *in*version, the extremity of the tibia is mostly broken off. When with this fracture the foot is displaced *outward*, and its outer edge raised, the accident is known as "Pott's fracture" (Fig. 468), and under these circumstances the external ligament remains entire, the force being concentrated against the fibula from two to three inches above the malleolus; the internal ligament, however, is ruptured, or the inner malleolus is fractured. Displacement of the foot is not necessarily an attendant upon the fracture. It seems to be the result of some continuation of the primary fracturing force or of some additional force, such as that of an attempt to walk. In the indirect fracture, the line of fracture is probably oblique, the obliquity being determined by the direction of the force.

FIG. 527.



Arrest of growth in shaft of right tibia (1 inch), with bowing of fibula, following injury to upper epiphysis two years before, in child, æt. 8.

Diagnosis.—In fracture of either of the leg-bones alone, the diagnosis may be somewhat difficult, and more particularly when no displacement is present. Crepitus may at times be made out by a forcible attempt to move or bend the lower fragments, or, by some sudden inversion or eversion of the foot, but the surgeon should be careful in trying for this not to do harm. Local pain, however, caused by pressure with the thumb over the seat of fracture, and linear ecchymosis a few days after the accident are valuable helps to diagnosis in these as in all other kinds of fracture.

Protracted or repeated examinations of the injured limb should always be avoided, they only add to the mischief.

TREATMENT.—In fractures of either of these bones, a natural splint is always found in the sound bone, consequently any shortening or deformity rarely follows the accident. What the surgeon has to do is, simply to apply some splint to ensure rest to the broken bone and to the muscles that move the foot—to the inside of the leg when the fibula is broken (Fig. 529), and to the outside when the tibia (Fig. 528); the splints should have a foot-piece. In fractures of the lower third of the fibula, the foot may be drawn inwards, the bandage being applied from without inwards, but in many instances, nothing more is called for than absolute rest. In other cases, a thick pad is often of use opposite the seat of fracture. In no case should the bandage cover the fracture. After the lapse of a few days or at most a week, when all swelling with other evidence of local injury has subsided, the limb may with advantage be put up in some immovable apparatus.

FIG. 528.

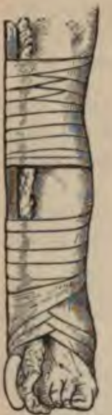
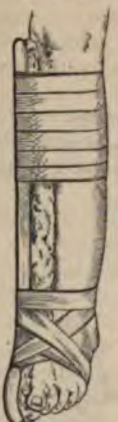


FIG. 529.

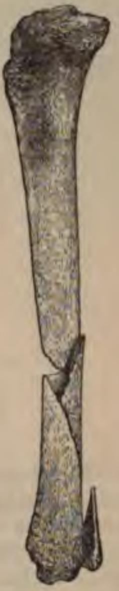


In cases of Pott's fracture, or dislocation of the foot outwards with fractured fibula, Pott used to place the patient on the affected side, with the injured limb flexed, fixing the leg upon an outside splint; an inner splint being likewise very usually applied. A better plan, however, is found in the posterior and two lateral splints, with a swing, as seen in Fig. 532, this mode of swinging the limb being a very good substitute for Salter's swing (Fig. 533).

Fractures of both bones occur in every variety, and the most common is the transverse about three inches above the ankle, but every form of oblique, dentated, comminuted, and vertical fracture is met with (Fig. 475). When near the joints, the vertical into the joint is by no means rare. The surgeon in his first examination of the fractured limb should, if possible, make out the line of obliquity of the fracture and the *tendency* one or other of the fragments may have to ride in any one direction, always observing the utmost gentleness in his manipulation.

When the tibia is broken at the junction of its middle and lower thirds, and the extremity of its upper fragment on its inner or subcutaneous surface presents a **V**-shape (Fig. 530), the surgeon may expect to find a fissure in the lower fragment of bone, starting from the apex of the **V** and running in a spiral direction inwards, backwards, and outwards round the inner edge of bone, across its posterior surface towards the lower articular facet where the tibia and fibula articulate, the fissure then passing horizontally inwards across the lower articular facet of the tibia to the posterior border of the inner malleolus, to join the one on the posterior aspect of the bone, thereby cutting off a triangular fragment of the tibia at its lower extremity.

Fig. 530.



V-shaped fracture of tibia with spiral fissures. Figure taken from a preparation of Gosselin's now in Dupuytren's Museum.

This variety of fracture is generally produced by some sudden twist of the body when the foot is fixed.

It may be suspected during life, when joint complications are associated with the fracture. It was first described by M. Gosselin ('Gazette des Hôpitaux,' 1855).

When compound, it is generally of a serious nature, and, according to Gosselin, should be treated by amputation, Dr. R. M. Hodges, of America, going so far as to say that by such a practice alone can the patient's life be saved ('Boston Med. and Surg. Journal,' Jan. 1877). Death usually takes place from pyæmia in cases that are left alone.

I am disposed, however, to go so far in this direction, though I fully recognize the serious nature of these cases and believe that they claim the surgeon's anxious attention.

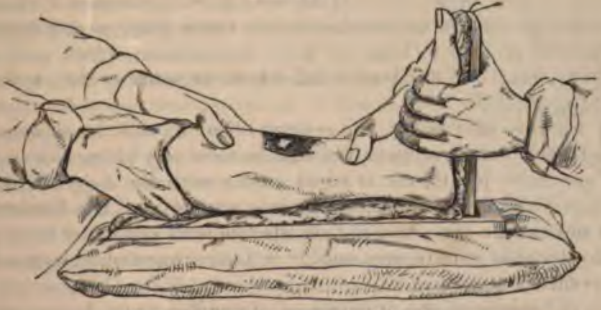
In transverse fractures there is rarely deformity. In the oblique, it is a common result—the upper extremity of the lower portion of bone, projecting, as a rule—the lower fragment being rotated outwards from the great tendency the foot has towards eversion.

The symptoms of fracture of the leg are too plain to be overlooked. The tibia being a superficial bone, any solution of continuity or deviation of the line of its spine is readily made out, the nature of the accident, loss of power, deformity, and crepitus, helping the diagnosis. In fractures near the joint, it may at times be difficult to make out whether the bone is fractured into the joint or not, and when a doubt exists, caution in prognosis and treatment should be observed. In fractures close to the ankle accompanied with displacement, dislocation may be roughly simulated, but the slightest care ought to detect the true nature of the case; the facility with which the displacement of the parts is rectified, the fact that the malleoli retain their normal relative position with the foot, and that the ankle-joint moves with facility, proves that the displacement is due to broken bones and not to dislocation of the joint. When the lower epiphysis of the tibia is displaced with the foot, there may be some difficulty in making out the true state of the case, but such an accident can only occur in children; it will appear as a transverse fracture, but with no sharp edge of bone as is usual in fracture, while replacement of the displaced fragments will not give rise to the ordinary crepitus of broken bone, but to a more subdued sensation.

When a wound complicates the case, the diagnosis is readily made.

Treatment.—It is wise, in fracture of the leg, as of other bones, to "set" the fracture, and to put the injured limb into the right position with good splints *as soon as possible.*

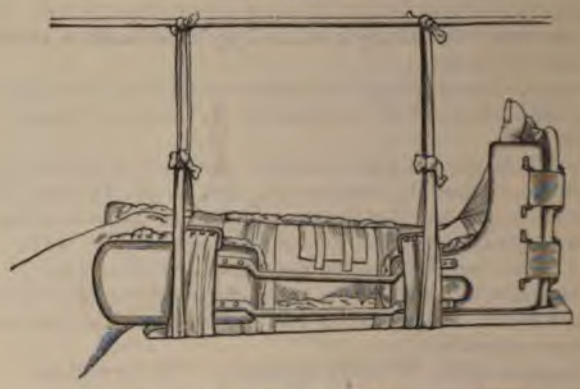
Fig. 531.



Process of setting a fracture of the leg.

In a general way, for fractures of the lower two-thirds of the bones, the best apparatus is a straight, flat, and not too broad, metal or wooden posterior splint (Fig. 531), with a rectangular foot-piece and two broad lateral splints (Fig. 532), all being well padded and firmly fixed by broad strips of strapping, broad bands of inelastic webbing or bandages, the seat of fracture being left exposed, if possible, for observation. In Fig. 532, the whole apparatus is illustrated with an interrupted splint as for compound fracture. In reducing a fracture of the leg, the knee should be partially flexed or held by an assistant, the surgeon manipulating the lower portion (Fig. 531).

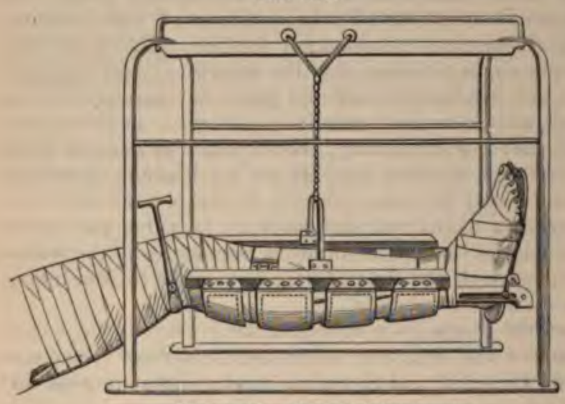
Fig. 532.



Apparatus for fixing and swinging a fracture of the leg.

During the putting up of the fracture, the limb must be kept extended and the broken bones maintained in position, it being a good plan to fix the foot and limb at first to the posterior splint, and subsequently to apply the lateral. The leg afterwards should be slung to a cradle by bandages (Fig. 532), or Salter's cradle may be used (Fig. 533). When any wound in the soft parts exists, as in compound fracture, the corresponding lateral splint should be interrupted, as shown in Fig. 532.

Fig. 533.



MacIntyre's splint and Salter's swing.

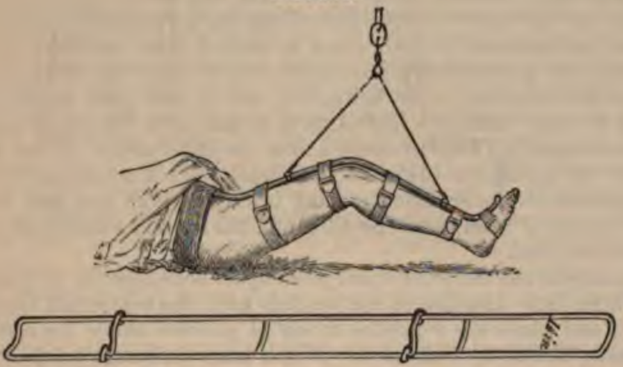
When the fracture is close to the ankle-joint, and any difficulty is experienced in keeping the broken bones in position from the spasmodic action of the tendo Achillis, the tendon should be divided. This simple operation at once permits the parts to be adjusted with admirable facility, and renders the retentive apparatus of real value, while it allows natural processes of repair to go on uninterruptedly, the divided tendon and broken bones undergoing repair together.

When the fracture is near or into the knee, a posterior splint, such as that of MacIntyre or Amesbury, may be employed; indeed, some employ this splint for most fractures of the leg (Fig. 533).

In setting any fracture of the leg, the opposite limb should be exposed as a guide, and an inquiry made to prevent error as to the existence of any natural or acquired deformity. The foot should generally be placed at right angles with the leg, with the sole flat to the foot-piece, care being observed that the heel does not fall and the lower fragment of bone consequently tilt upwards. The heel should also be well protected from pressure, and the foot covered and protected with cotton-wool. "Take, therefore," writes Paget ('Lancet,' Feb. 27, 1869), "the foot-piece of the splint as the guide for the position of the foot; and if you but see, in the management of fractures of the leg, that the foot of the patient and the foot-piece of the back splint fairly correspond, it is hardly possible for the limb to fall into any defective method of repair. Correspondence between the axis of the foot and of the foot-piece insures that there shall be no rotation or version, either outwards or inwards. Then, again, you should be careful that the foot touches the foot-piece by the three balls of the sole—the ball of the heel, the ball of the great toe, and the ball of the little toe."

Dr. Shrimpton, of Paris, acting upon Dr. Nathan Smith's suggestion of an anterior wire splint, has applied it to fractures of the leg, with success. He employs a splint composed of double wires an inch and a half apart, held together by four transverse bars, and applied by means of straps to the front of the leg, as illustrated in Fig. 534 ('Lancet,' 1872), the limb being subsequently slung in a vertical direction, as Esmarch slings his patient's leg in disease of, or after operations upon, the ankle. After the limb has been kept in splints for about a month, some immovable apparatus such as the flannel Bavarian (Fig. 479) may be substituted, and the patient allowed to get up, moving about with crutches for another month. When there is little or no displacement and little swelling, as soon as the immediate effects of the injury have passed away the immovable splint may be at once applied, that is, after the first week, the wants of the individual case being the only guide to its treatment. When the bones are comminuted and some loose portion has a tendency to ride or rise out of its position, the application of a pad, with sufficient local pressure to keep the parts in position, may be employed. When much effusion of blood or local action takes place, ice or cold lotion may be used as an application. Constitutional symptoms can be treated as they arise.

FIG. 534.



Nathan Smith's anterior wire suspension splint, with Dr. Simpson's modification of it below.

Compound fractures of the leg ought to be adjusted in the same way as the simple, care being taken to have an interruption in the splint corresponding to the wound (Fig. 532). When the wounds are extensive, the posterior hollow splint of MacIntyre, or any of its modifications, may be used with advantage.

When the bones are comminuted, the loose pieces should be removed, the wound cleaned and sealed with a pad saturated with blood, the compound tincture of benzoin or carbolic acid, as already described; at a later period of the case, when inflammation and suppuration take place about the seat of fracture, a free incision should be made down to the bone, and any necrosed fragment removed. This operation gives relief to pain and expedites recovery.

When the injury to the soft parts is great, and the large vessels or the joint are involved, amputation may be called for.

About one in every three cases of fracture of the leg is compound, the average mortality of the compound being also about one in three. Of those amputated, about 60 per cent. are fatal.

When amputation is called for, a primary operation, *i. e.*, one performed during the first three days, is better than a later one.

Fractures of the foot, commonly the result of some crushing force, are always serious, on account of the injury the soft parts have sustained in common with the bones. When not so complicated, severe fractures of the bones of the foot as well as other bones will recover by rest and the application of cold lotions, etc.

Fracture of the *os calcis* may occur by a fall from a height. It is seldom associated with any displacement, and undergoes excellent repair when natural processes are left to themselves. In exceptional cases the broken fragment may be drawn up by the action of the gastrocnemii muscles, and, under such circumstances, the leg must be kept flexed and the foot extended to keep the fragments in position by some outside splint. Under these circumstances, however, the foot rarely recovers completely its natural use.

Fractures of the *astragalus* also occur from some fall or violence and are often compound. I had a case some years ago, in which the upper surface of the bone with its head was split off and forced through the skin, and a second in which the bone was crushed into fragments and extruded from below the external malleolus. In the former the soft parts were so injured that amputation was performed; while in the latter, recovery took place by natural processes with a stiff but good limb.

Simple fracture may, however, occur, and I am disposed to think it is more common than is supposed, but the injury is difficult to diagnose, particularly when no displacement coexists. I have had occasion in two cases to remove from boys who had acute inflammation of the bone and joint, following an injury, the whole of the necrosed upper articular surface, with half the thickness of the astragalus, and in both good results followed. The piece I removed in both instances looked as if it had been fractured, and subsequently died. I have also recently (1878) removed from the inner aspect of the ankle of a man, the upper half of the astragalus that had been fractured six months previously, and displaced so as to present its upper articular facet inwards. The case had been reported at a sister hospital as one of fracture of the tibia and fibula. The fractured bone had subsequently inflamed and died.

Compound fracture of the *metatarsal* and *phalangeal* bones should be treated on ordinary principles, the immediate dressing of the wounds with the compound tincture of benzoin to exclude all air and place the wound as much as possible under the condition of a subcutaneous one being absolutely indicated. When parts irreparably injured require to be taken away, no healthy structures ought to be sacrificed in order to perform a named operation.

COMPLICATED FRACTURES.

Extravasation of Blood.

Fractures are very often complicated with *extravasation of blood*, when difficulties may be experienced in deciding whether the blood comes from an artery or a vein. In compound fracture, however, the difficulty of diagnosis is less than in the simple, since the florid character of the flowing blood, its pulsatile stream and capability of being arrested by pressure on its cardiac side, indicate its arterial source. In simple fractures, the difficulty is sometimes very great, particularly when the limb is distended with blood, and there is no pulsation in the swelling. When the vessels below the seat of injury pulsate naturally, the blood has probably a venous origin, but when pulsation is not felt, there is no reason to jump to the conclusion that arterial laceration has taken place, as the arteries may be simply pressed upon by the effused blood. When the swelling itself pulsates the diagnosis is simplified, for such pulsation generally means that a traumatic aneurism has formed, and some large artery been ruptured. In a clinical point of view, however, the question happily is not very material, as surgeons are now tolerably well agreed as to the practice to be pursued.

Treatment.—In *compound fractures* the injured vessel should be tied or twisted, and the wound should be enlarged for this purpose when necessary; and even where such a practice is impossible, and from the nature of the fracture and condition of the soft parts it is probable that the limb may be saved, the main artery should be tied higher up, as fractures heal well with a diminished supply of blood. Years ago, when a student, I remember a case of Mr. Bransby Cooper, in which a compound fracture of the leg was complicated with a laceration of the femoral artery, and the artery was secured at the seat of injury. Repair went on as well in the fracture as in any case I ever witnessed. Mr. Bransby Cooper has also recorded in his 'Surgical Essays' a case of fracture of the femur where the femoral artery was ligatured for a ruptured popliteal artery, and recovery took place in six weeks.

In the autumn of 1873, a youth, æt. 18, came under my care with a compound fracture of the condyles of the humerus into the elbow-joint, and an injury to the brachial artery about its centre, sufficient to arrest all circulation through it. The wound into the joint was extensive, but as my dresser had sealed it well with lint soaked in the compound tincture of benzoin before I saw it, I thought it wise to leave the case to nature. The youth went on well without one bad symptom, and left the hospital with a movable joint. I am disposed to attribute the well-doing of this case to the fact, that the brachial artery was obstructed.

When, however, the condition of the limb at the seat of fracture is such as to forbid any hope of its recovery being entertained, primary amputation ought to be performed; if a doubt exists as to the probability of the limb being saved, the artery should be secured in or above the wound; and amputation should be performed as a secondary operation if the attempt fail to save the limb; the chances of a successful result in primary and secondary amputation being about equal.

In *simple fracture*, when there is great effusion of blood and no pulsation in the swelling or vessels, the expectant treatment is the right one to adopt, the injured limb being kept at rest and elevated, and cold applied. When pulsation in the swelling is felt, and it is clear that arterial laceration has taken place, the same practice ought also primarily to be adopted, since every hospital surgeon knows that these cases often do well under such treatment. I can recall several where it was as clear as symptoms could define that with fracture of the bones of the leg severe arterial laceration existed, and yet a good recovery ensued. To cut down at the seat of injury and secure the wounded artery is what no one at the present day advocates, although John Bell laid it down as a law, that such a rule should be followed; but to do so above the seat of injury is one that commends itself to the surgeon's attention, when it is clear that some treatment is requisite for the wounded vessel and that the fracture and parts around are progressing towards recovery. When gangrene of the limb threatens, it would be as unscientific as it is useless to adopt this practice; amputation, under such circumstances, being alone applicable.

By way of summary it would appear that in *compound* fracture complicated with arterial hemorrhage, the vessel ought to be secured if possible, in the wound, if not above it; and that primary or secondary amputation should only be resorted to when the local injury forbids any hope of a natural recovery being entertained.

In *simple fracture* the expectant treatment should, as a rule, be adopted. If from the progressive character of the hemorrhage, interference is absolutely demanded, the artery should be secured above the fracture, and amputation had recourse to when gangrene of the limb follows. Pressure upon the afferent artery is a practice that also demands attention.

In exceptional cases, it may be expedient to cut down upon the wounded vessel at the seat of injury.

FRACTURES IMPLICATING JOINTS.

These are generally grave injuries—though in *simple* fractures the worst effect that is usually to be looked for is some stiffness or anchylosis of the articulation. Yet this result is not constant, and a movable joint is not rarely secured. As a matter of precaution, however, the surgeon should warn the patient of the risk, and be careful always to adjust the fracture and limb in the most useful position for a stiff joint. Such cases require very careful treatment, absolute immobility of the injured bone and articulation being essential points to be observed; the joint, if inflamed, must be treated upon ordinary principles. Passive movement of the joint should be commenced after the lapse of four or five weeks.

Compound fractures into joints are among the most serious cases the surgeon has to treat, and in the lower extremity generally require amputation. In the knee-joint, this practice is the best when the wound is great and fracture severe, though exceptional cases are on record in which excision has been employed. In less severe examples an attempt to save the member may be made, secondary amputation being performed when ill-success follows. The same rules are applicable in these cases as in wounds of joints, a simple fissure of bone adding but little to the danger; while severe comminution reduces the prospects of success to a minimum.

In compound fracture into the ankle-joint without displacement, no operation is usually called for, since good results are obtainable by conservative treatment.

In compound fracture of the shoulder- and elbow-joints, amputation is rarely required unless the parts are irreparably crushed, or the patient is so old as to forbid any hopes of recovery being entertained. Yet in many cases excision should be undertaken, as it is wiser to excise the articulation at once with the view of securing movement, than to look for a recovery by natural processes where anchylosis must be expected, unless, indeed, the wound is small, the injury to the bones slight, and the patient young.

In compound fracture of the wrist, no operation is required as a general rule.

By way of summary, compound fractures into joints should be regarded as cases of wounded joint, and treated accordingly, the amount of bone comminution and displacement having an important influence in determining the question and nature of operative interference, when such may be called for.

In large joints, where excision is inexpedient or dangerous, amputation must be had recourse to; in others, where excision is a sound operation, it should be preferred. In the ankle- or wrist-joint where the articular ends of the bones project, they should, except in young subjects, be removed.

Comminution of bones is a complication that requires a few observations, although in *simple* fractures it does little more than render difficult the treatment of the case and increase the risk of some shortening or deformity. When, however, it is the result of a direct force from a "spent ball," or other projectile, the comminution may be very great, the bone may be fissured and with the soft part contused; the danger of the case under these circumstances being much aggravated, not only from the direct effect of the injury, but from the ostitis that is so liable to follow.

In *compound* fracture, bone comminution has, too, an important influence for harm; adding greatly to the risks and dangers of suppuration and diminishing the probabilities of a successful result; since each piece of bone often acts as an irritant and retards recovery, and the fragments too often subsequently die. It is always well, therefore, in these cases to remove the detached portions, and, when the extremities of the bones are rugged, to excise them. Large pieces of bone, however, that are held by their periosteal coverings, must not be interfered with. This splitting and comminution of bone is most frequently met with in gunshot wounds, the conoidal of the present day splintering far more than the round bullet of former times.

In all cases of compound fracture where difficulty is experienced in reducing the projecting ends of the broken bone, the best course is to remove them with a saw, particularly when they are sharp; comminuted fragments should also be taken away. When much bone has, however, been removed, the surgeon should be careful not to separate the parts too much, for fear of want of union.

The subject of dislocation and fracture has been discussed in the chapter on dislocations.

Fracture from gunshot wounds will receive attention in the chapter devoted to gunshot injuries.

CHAPTER XXXII.

DISEASES OF THE JOINTS.

To assert that safe and scientific surgery can only be based on sound pathology may appear to be a somewhat trite observation; nevertheless, it is true, so true indeed that it cannot be impressed too forcibly on all who seek or profess to practise our profession. Moreover, it should be the aim of every surgeon whose duty it is to practise and to teach, to demonstrate the truth of the assertion, and to establish his practice upon such a scientific basis. It is with this feeling that I now propose to consider the pathology of joint disease, to explain briefly the changes which the tissues undergo during inflammation, and the results to which those changes lead; setting aside, for the present, disputed points of pathology, and reserving for future consideration the subject of tumors involving joints.

Diseases of a joint generally commence as an acute or chronic inflammation of the bone or synovial membrane, although in the progress of any case, and, of course, when disorganization of a joint has taken place, both become affected; the extent, however, to which either tissue will be involved will depend greatly upon the seat of the original disease. When it has begun in the synovial membrane and disorganization of the joint has followed, the disease in all probability will be found to have affected only the articular facets of the bones with the parts immediately beneath, and not to have involved the deeper structures. When the bones are the original seat of the mischief, and the inflammatory process has spread from them to the synovial membrane and disorganization of the joint taken place, the chief pathological changes will be seen in the osseous tissue, and either the whole or a part of the articular epiphysis, if not a portion of the shaft, will be involved in the disease. Under both circumstances, the cartilage covering the articular facets will have disappeared. When, however, the bones are the primary seats of disease, the cartilages are shed more rapidly, as the articular cartilages derive most, if not all, of heir nourishment through the bones; and, as a consequence, any perversion of nutrition and inflammatory changes of this tissue at once show themselves in the cartilages.

Practically, there is no such thing as a primary disease of the articular cartilages, no such process as so-called ulceration of cartilage, independently of disease of other tissues. When the cartilages undergo a change it is always secondary to some affection either of the synovial membrane, and then it is slow and partial in its action, or of the bone when it is rapid and complete. It should be remembered, however, that disease in the synovial membrane of a joint cannot exist for any time, or be of any severity without involving its ligaments, or the cellular tissue with which it is surrounded. Nor can inflammatory disease exist for any period in the articular extremity of a bone without more or less affecting its periosteal covering. It should be added too, that there is good reason to believe that either bone or synovial disease may be started by a severe sprain or laceration of ligaments at their osseous or periosteal attachments.

Before proceeding to consider the changes the different tissues undergo from the inflammatory process, it will be well to ask whether there is such a disease as strumous disease of a joint, strumous disease of the synovial membrane or bone?

If I were to answer this question according to custom as indicated by the free application of the term to joint disease, I should unquestionably say that it was a common affection, for there are few chronic changes of a joint that are not so designated, and it is rare to meet in a delicate child with any chronic affection of a joint which is not regarded by some as a strumous disease. Indeed, from the constant use of the phrase it might be thought, that the term strumous disease had some definite meaning or conveyed some definite idea, that the affection so designated was of a special kind, could be recognized by special features, and possessed definite pathological characteristics. Yet it can hardly be said that such is practically the case; for if we look for the points of difference between the so-called strumous disease and the chronic inflammatory affections we shall fail to find them, since they are not clinically to be distinguished, nor practically to be separated. Indeed, I am more than satisfied that the so-called strumous disease of a joint is nothing more than a chronic inflammation of the bones or synovial membrane, or both; that the pathological changes in the affected tissues are such as are clearly traceable to a *low form* of inflammatory action, and that they differ in no single pathological point from the inflammatory changes found in other parts. It is true that such affections, being of a low type, differ from other inflammatory actions of a more healthy character, but that they are nevertheless inflammatory there can be no doubt. Practically, therefore, it would be well to expunge this term "strumous" in respect of joints from our vocabulary; as its use certainly misleads, by making the student believe that the term has a definite meaning when it has not; and by encouraging the idea that the disease to which it is applied has a constitutional more than a local origin, and is consequently incurable. Of this, however, I am sure, that so-called strumous disease of a joint is as curable and as amenable to treatment as any other chronic inflammatory disease. In saying this, however, I do not dispute the fact that, pathologically, we do at rare intervals find tubercular deposit in some of the tissues building up a joint, and particularly in the bone; but I must repeat what I wrote many years ago in my work on diseases of the joints, "that such preparations being so rare are to be regarded as pathological curiosities." They are discovered also accidentally, and cannot clinically be recognized by any characteristic features from other cases of chronic inflammation of the bone. It would be well, therefore, to give up the term in scientific discussion, or, if it be used at all, to use it in the same sense as the words tumors, rheumatism, and fever are now employed, as a broad general term that includes many affections and covers much ignorance.

With these general remarks I now pass on to consider the changes the different tissues entering into the formation of a joint undergo in the inflammatory process.

ON THE PATHOLOGICAL CHANGES WHICH TAKE PLACE IN THE SYNOVIAL MEMBRANE FROM INFLAMMATION.

In a pathological point of view, inflammation of the synovial membrane may show itself in two distinct ways, firstly, in change of function, and secondly, in change of structure. The first change may take place without the second, but the change of structure necessarily includes an alteration in the function. The best examples of the first class of cases in which a change of function is the most prominent point, are seen in everyday practice in cases of so-called chronic or sub-acute synovitis, where excess of secretion in a joint is the main symptom, and in which this secretion may be reabsorbed and leave no trace of disease behind; whilst the best illustrations of the second class, in which change of structure is the main point of clinical as well as of pathological importance, are seen in the pulpy disease of the synovial membrane. Between the two great classes of cases, however, there are doubtless many links: for example, in acute synovitis we have change of structure even to more or less complete disorganization, and in chronic synovitis frequently repeated, we have change of structure such as gradually passes into the pulpy synovial disease. It would thus appear that in acute inflammation of the synovial membrane we have pathologically a series of changes that differ somewhat from those seen in chronic inflammation, and that while the acute form, it is true, passes into the chronic by imperceptible gradations, the two classes of cases are, nevertheless, very distinct. Acute inflammation of a synovial membrane in its early stage is pathologically represented by what my notes of cases clearly illustrate—a more or less minute injection of the capillary vessels, passing on to a velvety appearance of the synovial surface, a flocculent surface, or one covered with fine fringes of lymph, while in the more acute cases the synovial membrane may have disappeared by ulceration or sloughing, or have so softened down as to be destroyed on the slightest touch. In the former class of cases there will be clinically increase of secretion in the joint, severe local pain and heat with surgical fever; while in the latter, there will be acute suppuration, and the synovial membrane may show any one of the conditions already indicated; or they may have disappeared, pus and broken-up mĕmbrane alone remaining to indicate the local severity of the action as well as the destructive nature of the affection.

In intermediate or less acute cases, other changes may be seen, but they are not less marked. In one, the notes of which are before me, there was visible to the eye a local patch of capillary injection, and beneath it could be made out a superficial granular change of structure in the cartilage. In another, an effusion of a firm fibrinous layer of lymph over the surface of the synovial membrane and articular cartilage showed itself, and this membrane could be raised from its bed and peeled off, not only off the synovial capsule, but also off the articular cartilage, and beneath this membrane fine radiating capillary vessels passing from the margin of the articular cartilage towards the centre were clearly visible. In this case, moreover, after a section was made through the spot of injected membrane and cartilage down to the bone, the swollen layer of membrane passing over the cartilage was clearly visible, as well as the granular degeneration of the cartilage beneath; and this membrane could be separated from its cartilaginous connection by means of needles. It occurred in a child, but it seems to me to be sufficient to prove by means of pathology what anatomy has hitherto failed to settle, viz., that a layer of membrane passes over the articular cartilage. I have seen these changes more than once.

The changes that take place in the synovial membrane in sub-acute and chronic synovitis remain to be noticed, and they are essentially of the same pathological character as those we have been just considering, though they differ in this great point, that the synovial membrane is not destroyed but becomes thickened in various degrees by the infiltration within its walls and upon its surface of inflammatory product, and this thickening may be so great that the synovial membrane may be represented by a tissue an inch in diameter. It will, however, be found only in cases in which repeated attacks of inflammation have taken place, and many layers of lymph have been deposited upon and in the affected tissue. The layers may not be deposited rapidly one after another by consecutive attacks of chronic inflammatory action, for they may be the result of disease which has spread over many years, but they will always represent an inflammatory action of a chronic nature which at uncertain intervals has attacked the joint, and on each occasion left behind it pathological evidence of its presence by an inflammatory infiltration. In delicate and so-called strumous subjects, the product will be soft and pulpy, and in the syphilitic firmer and fibrous.

It is with such changes as these that all cases of the gelatiniform or gelatinous disease of the synovial membrane, as well as the pulpy disease of Sir B. Brodie, are unquestionably to be classed. Both are of the same nature pathologically, and clinically, at least, all my own investigations have led to this conclusion. I shall therefore employ the phrase "pulpy disease of the synovial membrane" to designate the changes which ensue in chronic inflammatory synovial disease. The term is short and as expressive as any other, besides being one with which the profession is familiar.

ON THE PATHOLOGICAL CHANGES THE ARTICULAR CARTILAGES UNDERGO FROM DISEASE.

The most important point the practical surgeon should recognize when considering the pathology of the articular cartilages has reference to the fact, that there is no primary disease of its structure, since pathological anatomy teaches us, that all the changes found in it are secondary to some other affection, and in the generality of cases, to disease in the articular extremities of the bones. There is no such disease, therefore, as primary "ulceration of the cartilages," and, when the cartilages are diseased, they are so from the extension of mischief from the bone beneath, or from the synovial membrane around or upon them.

Much has been written about the cartilages under the idea that they were liable to special diseases; and much error has consequently crept into joint pathology. The authority of great names, such as Brodie, Key, and others, having helped to encourage this idea. Modern investigation, as carried out by Redfern, Goodsir, and others, has, however, corrected this erroneous notion, and an improved pathology has clearly shown, that the diseases of the cartilages are secondary to diseases of other tissues.

Some years ago, when describing the results of my own investigations, I divided these affections into the *fatty*, the *fibrous*, and the *granular* degenerations, and nothing that has been observed since has led me to doubt its accuracy; indeed, additional experience has confirmed its truth. I am not about to enter, however, into a minute description of the different changes, for they can be read elsewhere; but it may suffice for my present purpose to remind the reader that the *fatty degeneration* of the articular cartilages is found in joints that have been deprived of their natural functions from any cause—from non-use in the majority of cases, but in many from bad nutrition—that it is found in common with the same change in the bones or other tissues. This fatty degeneration can be recognized with tolerable facility by the naked eye, for the cartilage so affected, instead of possessing its natural white pearly aspect, will appear somewhat transparent, with an undulating, unequal, although smooth surface. It will, when cut, feel softer than usual, and may be three or four times its natural thickness. At times it may even be "pulped" by firm pressure with the finger, and be separated from the bone with more than usual facility. Microscopically also it will present characteristic features. The natural cartilage corpuscles will have become changed into fat- and granule-cells in various degrees, and the hyaline matrix will be filled with cavities varying from the healthy standard to large spaces. These spaces moreover will be filled with the elements of fatty degeneration, into which the healthy corpuscles will have changed. This fatty degeneration takes place in most joints that have not been used, but rarely from disease of the joint itself. When, however, a joint so changed becomes the subject of inflammation, disorganization of the articulation rapidly follows, for such a degenerated tissue has no power of resisting disease, and disappears when attacked by it rapidly.

The fibrous degeneration of the articular cartilage is a disease of a peculiar character. I believe it to be associated with only one disease of a joint, which is "osteo-arthritis." It is very gradual in its progress and not characterized by any definite symptoms. It can be recognized pathologically in its earliest stage by the loss of the natural glistening aspect of the cartilage of a joint, the smooth surface of which disappears and looks rough. Small fissures involving more or less of its thickness next appear, which sometimes extend down to the bone, and, as a rule, are thicker in the centre, they occasionally radiate outwards. The cartilage seems gradually to become thin, and after a time to disappear, exposing the articular surface of the bone, which probably will have undergone the calcareous degeneration. Microscopically, the principal change that is seen in this disease is the gradual alteration of the hyaline structure into fibre. The cartilage-corpuscles at the first will be found interspersed between these fibres, but, at a later date, to have changed into granules. At the last stage nothing but fibres may be found, and when this condition exists, the total and rapid disappearance of the structure will not be far distant.

The granular degeneration of the articular cartilage is the most important affection of this tissue. It is the one most commonly found in joint affection, and seems to be the direct consequence of a perverted nutrition in the bone or synovial membrane from disease of these structures. Though of a simple nature, it shows itself in many ways, and, without microscopical investigation, must have appeared unintelligible. In its different forms it has doubtless led good observers to describe it as an ulceration of cartilage, for, under certain conditions, the cartilage presents a worm-eaten excavated appearance not unlike that which ulceration might produce.

The disease is essentially a granular degeneration, first of the natural cartilage-cells embedded in the hyaline matrix, and secondly, of the hyaline matrix itself. Let a cartilage-cell undergo this granular degeneration, and the granules by accumulation and multiplication form a cavity in the hyaline matrix. Let this cavity burst on the surface of the cartilage into the joint, and an excavation is formed which can be seen by the naked eye, and a so-called ulcer is produced. Let this change take place towards the margin of the articular cartilage, and we find an explanation of Mr. Key's observations upon so-called ulceration of this tissue in certain forms of inflammation of the synovial membrane of the joint. Let this change take place near the bones as a result of disease in their articular ends, and we find an explanation of the general condition of the cartilages in the bulk of joint diseases; for, when the bones entering into the formation of a joint are so affected as to interfere with the nutrition of the articular cartilages, the cartilage may either present the worm-eaten appearance all over or in part, or it may have been shed from its bony attachment, when it will be found to be lying upon the bone as a foreign body in the joint. In an early stage of disease, this granular degeneration may only be detected by a microscopical examination, although when it follows upon disease of the bone, the cartilage will always be found to peel off its articular facet with unusual facility.

In synovitis also, the surface of the cartilage in contact with the inflamed membrane will be found similarly involved. Should the disease be local, as is at times seen in cases of injury to an internal ligament such as the ligamentum teres, the change in the cartilage will be local only, but when general, the whole surface of the cartilage may be involved. In acute disease, acute degeneration follows, as is evidenced by daily practice.

On the Pathological Changes in the Bone the result of Inflammation.

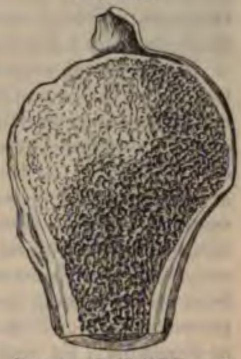
Inflammation of the articular extremities of a bone is a very common disease, and is probably the most common we have to deal with in connection with joints, for it would appear to be the cause of most, if not all of those cases of disease of the articulations which we find in children, and have been described as strumous or scrofulous disease of a joint. Some years ago, when writing on this subject, I stated that "I cannot for one moment doubt that the majority of the cases which are described by surgeons as strumous or scrofulous disease of a joint of the articular extremities of the bones depend upon a chronic inflammation in the bone," and all the experience I have gained since has tended to confirm me in this opinion. I believed then, as I believe now, that the disease in its origin and progress is inflammatory, and that it is as curable as any other local affection. It is important to bear this invariably in mind when examining or treating a case of disease of a joint, particularly when it is found in a so-called strumous or cachectic subject; for if we regard the disease as a constitutional one, we are apt to think it ought to be treated on general principles, and to neglect the local means by which alone a good recovery can be secured.

Let us now inquire into the changes that the bone undergoes during this inflammatory or wrongly called strumous affection.

The most striking is probably the earliest, which is the expansion of the articular extremity, and in some cases this will be very great, and generally uniform. The articular extremity of the affected bone, or the epiphyses of all the bones entering into the formation of the joint, will appear to be rounded and generally enlarged. Upon making a section of a bone thus affected, it will be found softer than natural, indeed, it may be so soft as to allow a knife to divide it, or even to break or crush it on firm pressure. To the eye, the section will appear more vascular than natural, the cancellated portions more cancellated, the cells enlarged, and the bony septa radiating from the shaft in a broad, palm-like fashion. The cells will also be found filled with a pinkish serum.

If the disease continue, and the inflammation be of a healthy type, parts of the bone will appear denser and more indurated than the remainder; its cancelli will be filled with inflammatory products which have organized, and the bone will appear on section as a dense and apparently bloodless mass surrounded by other vascular cancellated tissue. Should the inflammation be of an unhealthy character, diffused suppuration within the bone will take place, and death of the bone, wholly, or in part, follow. Under these circumstances, the disease will probably have become a genuine joint affection, and have extended to the synovial membrane of the joint, and set up disease within its substance. This extension of disease will show itself by effusion within the joint, by pulpy thickening of the synovial membrane, and of the cellular tissue around the articulation. Up to this point the disease has been local, involving only the articular extremities of the bones, and has not attacked the proper joint structures, and appears also to be perfectly curable. But at this stage of the disease the articular cartilages will have become affected; for when the inflammatory action has continued for any period, and not shown any indications of subsidence, but, on the contrary, has either assumed an unhealthy character, or interfered with the nutrition of the articular lamella of bone upon which the cartilages rest, the articular cartilage to a certainty will undergo a granular degeneration upon the surface in apposition with the bone, become loosened from its attachment, and be thrown off or shed (Fig. 535); or it may degenerate in patches and present to the eye an irregular excavated surface. If the disease be chronic, the cartilage will degenerate slowly, and be as slowly loosened from its osseous base, when it may readily be lifted off the bone by any instrument. If the disease be more rapid, the cartilage will likewise be shed more rapidly, raised as a blister off the bone, or found lying upon it as a foreign body, when under the microscope, it will appear to have undergone the granular degeneration.

FIG. 535.



Drawing (G. M. 3030*), made to show the shedding of the articular cartilage in ostitis.

When the disease is acute, the cartilage may disappear altogether, having been shed from its osseous base and become rapidly degenerated.

The articulating surface of the bone during this time may appear in some cases as in inflammation, only extra-vascular; in others, it may be rough, or, so-called, ulcerating; while in a third class the articulating facets will have been shed wholly or in part. In a still worse class, pieces of necrosed bone involving more or less of the articular extremity of the bone will be seen, while in the worst, an abscess will have made its way into the joint of the diseased articular extremity. In all these conditions, the cartilages will have disappeared, and the joint become disorganized. These pathological remarks are applicable to every articulation, to the hip as much as to the knee, and to the shoulder as to the elbow.

CLINICAL SYMPTOMS ASSOCIATED WITH THESE PATHOLOGICAL CHANGES.

The symptoms, by which these pathological changes which have been described can be recognized, vary according to the formation and surroundings of each joint, but in their general character they are the same. *Any inflammation of the synovial membrane* of whatever kind, always shows itself within a few hours or days of its origin by effusion, and consequently by distension of the articulation, while in the knee, ankle, elbow, wrist, shoulder, and other joints, this clinical condition makes itself manifest in a way which cannot be misinterpreted. The synovial sac becomes enlarged and distended by the effusion, so that it bulges between the bones and gives an outline to the joint unlike that furnished by any other condition. In the hip-joint similar changes take place, but they are not quite so palpable, though they can be made out by a careful examination, and particularly by a comparison of the affected with the sound side, a point of practice which should never be omitted in the examination of any injured or diseased joint; the soft parts in front of the joint will be more prominent and full; pain will be produced by gentle pressure made upon the part, particularly behind the great trochanter, where a soft swelling, which will be manifest to the eye, will also exist in lieu of the natural depression. Even fluctuation may be detected through the joint on careful palpation. At any rate, to the eye and hand there will be clearly some extra fulness of the soft parts, sufficient to lead a surgeon to suspect the true nature of the disease.

In disease of the articular extremities of the bones, a different clinical condition will be present. At the commencement of the disease, and sometimes for a lengthened period which varies in each case, an aching of the part is the only local symptom. This aching may be of greater or less intensity, and depends much on the severity of the disease. It is too often regarded as "growing pains" or rheumatism. What I wish now to note is, that local pain is the first clinical symptom and not effusion, and that there is no enlargement of the affected joint. As the disease progresses, however, an enlargement may be detected, which in the hip can be made out by manipulation; whereas in the knee or other joints, it may be visible to the eye. It will, however, be an enlargement clearly of the bone, a thickening or expansion of the osseous structure unlike that existing in synovial disease, there will be no fluctuation, no soft yielding of the parts, but clearly an expansion of the osseous structure, an enlargement of the articular extremity of the bone, while the soft parts over the enlarged bone are quite natural. With this aching of the part, there may also be increase of heat as an early symptom, yet this symptom is not constant, although almost uniformly so; it will, moreover, be intermittent, and, as a rule, show itself as a general periodical flushing of the part.

In chronic synovitis which leads to joint changes, the joint may probably be gently moved without exciting pain or spasms of the muscles that move the articulation. Pressure upon the part with the fingers will probably excite it, although moderate pressure of one bone against the other may be made without giving rise to any indications of distress.

In diseases of the bone entering into the formation of the joint, these clinical conditions do not all exist. The joint may be moved quietly, without exciting pain, but the attempt will, as a rule, excite spasm of one or more of the groups of muscles which move the articulation. Moderate manipulation also will be well borne. Firm pressure upon the bone so as to bring the two articular surfaces in contact will always excite pain, not the pressure produced by a jar, such as in the hip is caused by a sudden blow upon the foot or trochanter, for such a mode of investigation must be looked upon as rough and somewhat uncertain; indeed, it is almost sure to excite a start in the patient and an expression of pain, but the pressure which is produced by a steady force applied by the hand to the trochanter towards the pelvis, or through the foot to the articular extremities of the bones; a pressure which, in synovial disease, rarely, if ever, gives rise to pain, but in osteal disease invariably excites it.

These symptoms in the two classes of cases appear clearly to indicate the two distinct affections in their early stage. They apply to all articulations, and may be thus summarized:—

In **synovial disease,** swelling is the earliest clinical symptom, with more or less fluctuation, each joint showing this in its own way. As a rule, this swelling is unattended with much pain. Pressure on the joint causes pain, although gentle movement may be made without increasing it or exciting spasm of the muscles which surround the joint. Inter-articular pressure can generally be tolerated.

In **articular ostitis,** pain is the earliest and most constant symptom—pain of an aching character varying in intensity and generally increased by firm local pressure. There will be no visible enlargement of the part for some weeks or months, and no fluctuation. Gentle movement, generally, excites spasm of muscles about the joint, and inter-articular pressure always increases this and causes pain. Increased heat also exists about the parts and is of an intermittent character.

DISEASES OF SPECIAL JOINTS.

Diseases of the Hip-joint.

Authors have hitherto led their readers to look upon diseases of the hip-joint as a special or peculiar affection, and to regard it pathologically and clinically as distinct from diseases of the other joints. Such, however, is not the case, for diseases of the hip-joint differ in no single pathological point from those of any other articulation.

It has also with too much confidence been described as a "strumous disease," as if all diseases of the hip-joint or of any joint were generally of this nature, or found in subjects only of a strumous diathesis; as if all had a constitutional and not a local origin.

Hip-joint disease is a local disease, and is mostly set up by local causes. It is, moreover, as amenable to local treatment as any other affection. "It occurs very frequently in strumous children," says Mr. Holmes, "a circumstance which has led to its being denominated 'strumous,' but it seems to have no necessary connection with struma, unless so wide a signification be assigned to that somewhat vague term as would render the designation itself unmeaning. If by struma be meant a state of the system which renders the subject of it prone to the deposit of tubercle in the viscera, I think that there is good reason for asserting that morbus coxarius often attacks children who are not strumous—*i. e.*, who do not display any such tendency to the deposit of tubercle—and therefore that no decisive proof of any strumous tendency is afforded by the presence of the affection. If, on the contrary, struma be defined as that condition of the system which disposes its subjects to the development of low inflammations of various kinds, then it is difficult to see what is the significance of the designation." It would, therefore, be well to discard the erroneous notion that hip disease has its origin in a constitutional cause, for till that is effected the local treatment is likely to be disregarded or looked upon as of secondary importance, when all who have much experience in the treatment of these cases will admit that local treatment cannot be made too prominent a feature.

It should therefore be looked upon clinically as a local affection and to be treated by local means, such constitutional treatment being employed as the general condition of the patient may appear to warrant, the same principles of practice being applicable in these cases as have been found of value in other joint affections.

Hip disease, unfortunately, is a very common affection, and my own statistics inform me that it forms about 30 per cent. of the joint cases admitted into a metropolitan hospital. It is also an affection of child life, for out of 360 cases of which I have notes, 62 per cent., or nearly two-thirds, occurred in children under ten years of age, and four-fifths in patients under twenty, that is, it occurred during the period of the growth and development of the bone, and not during that of its full maturity. This point will be seen on reference to the following table:—

Table showing the ages at which hip disease commenced.

Four years and under	126 cases	223 cases, or 61.9 per cent.
Between 6 and 10 years of age	97 "	
" 11 " 20 "	86 "	or 23.8 per cent.
" 21 " 30 "	27 "	or 7.5 "
" 31 " 40 "	13 "	or 3.6 "
Above 40 years of age	11 "	or 3 "

230 of these cases were collected by me when acting as registrar at Guy's from 1853 to 1861; and 130 are from the notes of cases which have been under my own care.

It is found in the male and female subject in equal proportions, but appears to attack the left more frequently than the right limb, 60 per cent. of my cases having occurred on the left, and 40 on the right side, and this proportion is very similar to that published by Mr. Lonsdale in the 'Lancet' for September 8, 1855, where out of 112 cases of deformity of the hip, 65 were of the left and 47 of the right side.

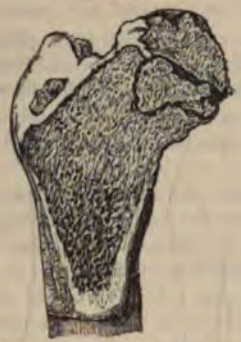
Pathology of hip disease.—It has been already stated that in a pathological point of view, hip disease differs in no respect from that of other joints, and is not a strumous affection although it may occur in strumous subjects. It may also be repeated, that it is a very rare thing to find strumous or tubercular matter in a diseased hip-joint. Excluding new growths, disease of the hip consequently means, inflammation of the bones or soft parts entering into the articulation.

In the pathology of joints, few points probably have been more disputed than the seat of the disease in hip-joint affection; and I believe the difficulty has been entirely raised on the mistaken notion, that the nature of the affection was different from that of other joint diseases. We have never heard much importance placed upon the point in diseases of the knee, shoulder, or other joints. The question as to the origin or not of disease of the knee in the crucial ligaments, or of disease of the shoulder in the long tendon of the biceps, has never been very warmly discussed. And yet we find men gravely discussing the question as to the origin of hip disease in the ligamentum teres. My late much respected teacher, Mr. Aston Key, laid great stress on this point, and believed that it was from that ligament and its attachments that disease of the hip-joint generally proceeded. Pathology has, however, made great advances since those days, and we now know that disease in a joint (hip or other) may have its origin in the bones which form the joint, or, in the soft parts or ligaments that hold them together. Experience, moreover, has taught us that we may have an acute inflammation of the synovial membrane rapidly going on to complete disorganization of the ligaments, cartilages, and soft parts of the joint, and even causing death of the bones entering into its formation. The inflammation may be so acute as to render it difficult at the post-mortem examination to read the pathological facts correctly, for when such changes as these take place, it is fairly open to question whether the inflammation originated in the synovial membrane and spread to the bones, cartilages, and ligaments causing their destruction; or, whether it began in an osseous centre and extended to the joint. This difficulty is experienced when the disease has been so severe as to cause a division of the pelvic bones into their original segments, or a separation of the epiphysis of bone forming the head of the femur from its normal attachment to the neck.

When the bones of the joint are equally involved in acute disease, it is probable that the mischief began in the synovial membrane and spread to the bone. But, when we find one bone more diseased than another, *e. g.*, the femur than the acetabulum, or *vice versâ*, it is probable, that acute inflammation originated in it and spread to the soft parts. These points, however, are to be looked upon as only feeble indications and not as definite guides, upon which an opinion may be formed. In chronic disease of the hip-joint, the question as to the seat of the original disease is not so easily answered, and yet, from what I have observed clinically and pathologically, the question is not one impossible to answer. When a joint is disorganized, its ligaments and cartilages gone, and the articular surfaces of the bone exposed, or perhaps diseased, there may be some difficulty in deciding as to the particular tissue in which the inflammation originated; but, when a section of the bone is made—*e. g.*, the head of a femur, or the head of a tibia—and a cavity, a sequestrum, or a suppurating bone is found communicating with the joint, probabilities certainly point to the bone as being the original seat of the disease. But it may be asserted that in such instances no one doubts the cause of the joint disease, since the pathological conditions clearly prove it; yet the clinical histories of such cases differ in no single point from those of others in which, perhaps, the same very marked evidence of disease is not to be seen, that is, if the joint be examined on its surface only. Indeed, to examine a pathological specimen of a bone or of a diseased joint, it is absolutely necessary to make a vertical section through the bone; since to look at it from the joint surface is most fallacious, and an opinion formed from the appearance thus acquired is too likely to be erroneous.

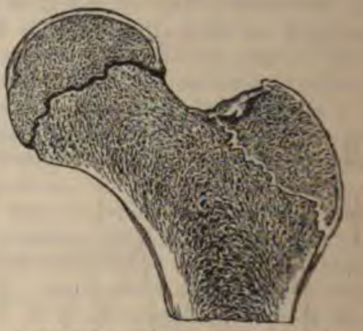
If we make, then, a section of the bone in chronic disease of the joint, we shall find in a large number of cases, especially in the young, hyperæmia of its articular extremity and condensation, if not suppuration or necrosis from chronic inflammatory action (Fig. 536); in fact, we shall find marked evidence of articular ostitis in one of its stages, for, doubtless, during young life this is the most common form of disease which precedes joint mischief, and from which joint disease proceeds. This opinion is also corroborated by the fact that, in our museums, almost every specimen of chronic joint disease reveals extensive bone mischief extending beyond the surface, and generally involving more or less of the articular ends of the bone which enter into the formation of the joint. In our Guy's museum, this point is very strongly displayed, and on looking over other museums and extensive notes of joint cases, the same truth is apparent.

FIG. 536.



Necrosis of the head of the femur, with sequestrum in its neck. Prep. 1318^8, Guy's Mus.

FIG. 537.



Separation of epiphysis forming the head of femur. Guy's Mus. Prep. 1315^{60}.

At times, however, the disease may primarily commence in the epiphysial cartilage situated between the head of the femur and its neck, the epiphysis as a consequence being thrown off (Fig. 537). This pathological observation must be looked upon as of great clinical importance, for if the majority of cases of joint disease is to be attributed to the extension of an inflammatory action from the articular extremity of a bone to the other tissues, it becomes a question of urgency to recognize the disease of the bone in its early stage, in order to prevent its progress to the tissues upon which the integrity of the joint itself depends; and clinically, there is good reason to believe that such can frequently be done. In the hip-joint it may be difficult, possibly more difficult than it is in disease of other articulations that are not so well covered in with soft parts, such as the knee; but it can be made out with care and discrimination even in the hip. And here it may be well to consider the clinical features upon which our diagnosis should be determined.

Diagnosis.—The necessity of making a correct and early diagnosis of hip disease scarcely requires illustration, and did not daily experience indicate that it is not sufficiently recognized, there would be no occasion to dwell upon it. The early symptoms of the affection, consequently, are important.

When a child after injury to the hip has joint pain and possibly limps, and these symptoms persist after all external evidence of injury has passed away, there is some reason to suspect the presence of joint mischief; and when this pain is increased by inter-articular pressure, by means either of the hand applied over the trochanter or by the patient standing or walking, the suspicion should be strengthened. When swelling of the parts can be made out, and some bulging of the synovial membrane, as shown by a fulness behind the trochanter and in the groin, is found to exist combined with tenderness, synovial inflammation is rendered probable; and when persistent pain without effusion is the more prominent symptom, aggravated by firm inter-articular pressure, bone mischief is indicated. When these symptoms appear after some fever or illness, or, indeed, without any such cause, they are of no less importance, although, probably, they are more liable to be overlooked.

As a clinical point of primary importance, all joint pain, and particularly hip-joint, claims attention, and when this is referred to the knee, the surgeon must not be misled. *Limping* of any kind always indicates something wrong—probably very wrong—more particularly when combined with joint pain, aggravated by inter-articular pressure. *Spasm of the muscles around the joint* is a symptom of great significance and a means that nature adopts to insure immobility of the affected articulation; in some cases, it will be so severe as to forbid all movement, but in others less marked; at one time it will be confined to one group of muscles such as the flexors, when the position of the limb will be determined, while at others, the rotators or adductors will be affected; but whenever it is met with, there is probably some affection of the joint itself, or of the bones that enter into its formation. When doubt exists as to muscular spasm being the cause of joint immobility, chloroform should be used, as all spasm ceases under its influence, and the head of the bone, by manipulation, rotates with more or less facility and smoothness, according to the amount of joint mischief that is present.

Position of limb as a means of diagnosis.—In the diagnosis or treatment of hip disease there is no point which deserves closer attention than the position of the limb, and I am disposed to think it has not received that attention, since experience has proved, that most of the cases of deformity met with after a natural cure of the disease are due to a want of appreciation of its importance.

FIG. 538.

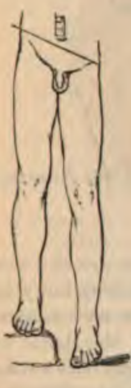


FIG. 538A.

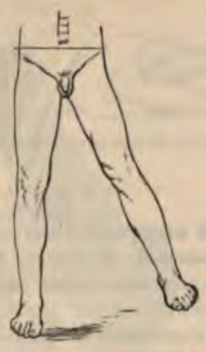


FIG. 539.

Apparent shortening of limb in hip disease caused by adduction.

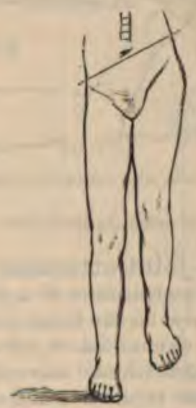


FIG. 539A.

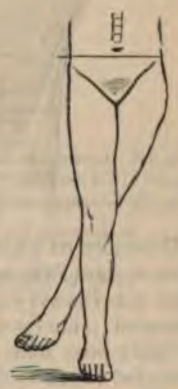


Fig. 538.—Apparent *elongation* of the left lower extremity in hip disease on the left side due to *ab*duction of the limb and the necessary tilting upwards of the pelvis on the sound side to allow the abducted limb being brought into a line with the body.

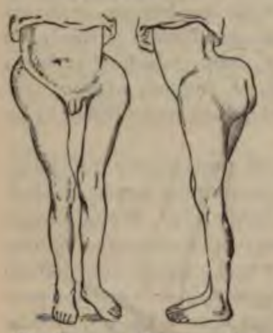
Fig. 538A shows the *ab*ducted position of the diseased left limb when the pelvis has been brought into its natural position at right angles to the spine.

Fig. 539.—Position of patient when standing with disease of the left hip joint and an *ad*ducted limb. The pelvis is tilted up in the affected side and the limb thereby apparently shortened.

Fig. 539A.—Position of the adducted limb when the pelvis is brought straight.

In one case the limb will appear elongated, but on measurement, no real lengthening will be detected, the apparent elongation being due to the tilting upwards of the pelvis on the *sound* side, from the patient either naturally throwing all the weight of the body on that side to take off pressure from the affected one, or, from muscular spasm, causing abduction of the limbs (Fig. 538). In another case the pelvis on the affected side will be drawn up, and tilted slightly backwards, the thigh becoming adducted and more or less flexed upon the pelvis (Fig. 539), or in some cases rotated outwards from the spasmodic contraction of the muscles that move the hip. In other and more advanced cases, genuine shortening of the limb may take place from either real loss of substance in the head or neck of the bone, or, in exceptional cases, from dislocation of the head of the femur upwards and backwards (ilio-ischiatic); and, in rarer examples, the neck and shaft of the femur may be separated and displaced upwards and backwards, the epiphysial head of the bone being left in the acetabulum. This probably occurred in the case from which Figs. 540–41 were taken. Where the joint is flexed, some special deformity (lordosis) will exist when the patient stands or lies, but this apparent spinal curve will, however, even in the worst cases, at once disappear when the patient is placed on his back and the limb raised (Figs. 542, 543), or when he stands with the leg flexed (Fig. 545). Apparent elongation of the limb under all circumstances means its *ab*duction; shortening of the limb implies *ad*duction; flexion gives rise to *lordosis*. These conditions follow necessarily any attempt of the patient to bring the sole of the misplaced limb down to the ground.

Figs. 540–41.



Displacement of femur, taken from William D—, æt. 9, following disease of five years' standing. There was some movement in the joint.

Flattening of the nates as seen in hip disease is due to a wasting of the glutei muscles from want of use, this symptom becoming more marked when the trochanter is rotated outwards and the foot inwards.

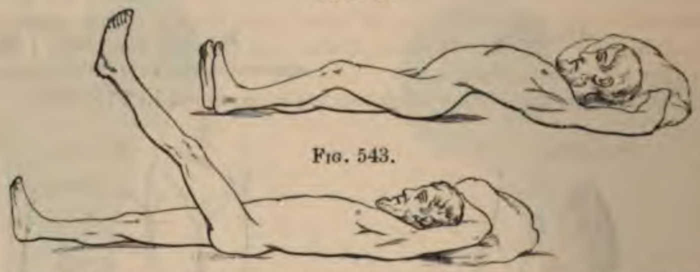


Fig. 542.

Fig. 543.

Fig. 542.—Lordosis of spine as seen with patient the subject of hip disease in recumbent position with femur flexed at angle of 130 degrees.

Fig. 530.—Lordosis effaced by elevating the flexed limb.

Disease of the hip-joint attended with suppuration.—These are the worst cases of joint disease, for suppuration of a joint generally means its disorganization; and when the disease has its seat in the bone, necrosis or some serious inflammatory change is indicated. Under these circumstances, all free movement of the head of the bone will probably have long disappeared, and more or less anchylosis or natural repair have taken place, for in joint affections reparative and diseased actions run much together. The limb may be found in any position, the flexed and adducted position of the thigh being the most common, particularly in neglected cases, as illustrated in Fig. 546; but, at times, the thigh will be rotated outwards, and even abducted. When sinuses exist, a probe may detect diseased bone.

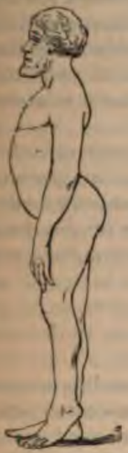
When dislocation is present, the symptoms will indicate its form.

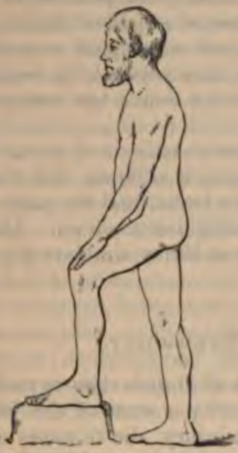
All cases, however, of suppuration about the joint, even when associated with disease of the joint, are not to be regarded as a direct result of disorganization of the articulation; since it is quite certain that inflammatory mischief may exist in the joint and subside, and yet be followed by suppuration in the cellular tissue about the part; and in this opinion, pathological does but confirm clinical observation. There may be some difficulty in making out such cases during life, but I have no doubt as to their existence. In the hip they are the more common.

Prognosis.—When hip disease can be arrested in its early stage a complete recovery may take place, more particularly when it has its origin in synovial inflammation, although when due to articular ostitis and the disease has been of long standing, a recovery will probably ensue with anchylosis. When the joint has suppurated and a natural recovery follows, it must be, in the large majority of cases, with fibrous or soft anchylosis; and in the minority with bony. In the 'Medical Times and Gazette' for 1869, I illustrated all these points fully by a series of cases.

FIG. 544. FIG. 545. FIG. 546.

Lordosis of spine in hip disease from flexion of thigh.





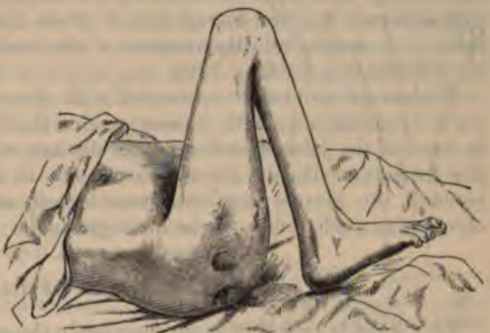


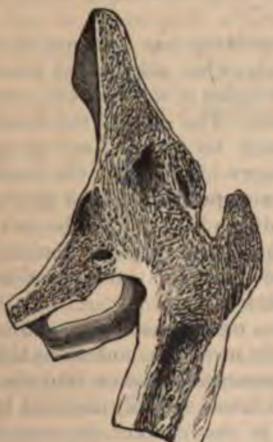
Fig. 544.—Anchylosis of left hip, at 130° producing lordosis when patient is erect.

Fig. 545—Lordosis remedied by raising limb.

Fig. 546.—Disorganization of hip-joint. From patient—Sarah B—, æt. 22, July, 1870. Excision of the joint was performed in this case, and a good result followed.

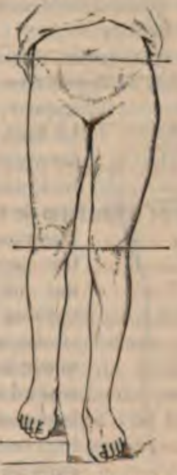
A very beautiful example of bony anchylosis is represented in Fig. 547.

FIG. 547.



Synostosis of hip-joint. Taken by my father, the late Mr. T. E. Bryant, from a man, æt. 42, who had had a stiff joint for thirty years. Prep. 1318^{46}, Guy's Mus.

FIG. 548.



Arrest of growth in the neck of femur as a result of articular ostitis.

It sometimes happens when articular ostitis has attacked the head and neck of the femur in childhood, and recovery has taken place with either a movable or anchylosed joint, that some arrest of growth in the bone may be the result. I have seen this in a child, æt. 8, who had been under my care when five years of age for articular ostitis, from which she perfectly recovered; the femur on the affected side being an inch shorter than its fellow, the trochanter nearer the median line of the body and the anterior superior spinous process of the ilium; the seat of the shortening being clearly in the neck of the femur, which had been arrested in its growth. (Fig. 548.)

The *diagnosis* of hip disease is to be made after a careful estimation of the value of the symptoms as a whole, and not upon one or more supposed typical symptoms. The limping of a child with infantile paralysis of the leg has been confused with that from disease of the hip; but the wasting of the limb and the absence of pain ought to prevent such an error. The pain of spinal disease, of psoas abscess, of sub-iliac abscess, of some glandular affection of the groin associated with limping, and nerve pain extending down the limb may mislead; but the knowledge of these facts may prevent the repetition of such mistakes. A congenital displacement of the head of the femur has been frequently mistaken for the affection (*vide* p. 769).

Disease of the bursa connected with the psoas muscle in front of the joint, which at times communicates with it, may render the diagnosis difficult, but the pain on pressure in front of the joint which exists in disease of the bursa, and the pain on pressure behind the trochanter in hip disease, is enough to distinguish the two. Disease of the bursa beneath the gluteus maximus muscle may also at times simulate hip affection, but with care the two affections can be distinguished.

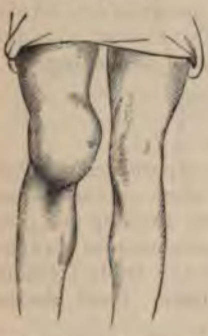
DISEASES OF THE KNEE-JOINT.

This joint is propably more frequently the seat of disease than any other, and in hospital practice, my own statistics tell me that it forms 40 per cent. of the joint cases admitted into Guy's. The greater liability of the knee to injury, the thinness of its natural covering, and the complicated formation of the joint, together probably afford the true explanation of this fact. It is met with, moreover, in patients of a more mature age than hip disease, 62 per cent. of hip cases and only 32 of knee disease being found in children under ten. It must be admitted, however, that the knee when once diseased is less likely to undergo a natural cure and much less a cure by anchylosis, than any other articulation. This is probably to be explained anatomically by the existence of the inter-articular fibro-cartilages, which, while in a healthy joint they tend to keep it healthy, in a diseased, by forbidding the contact of the two bones, render it difficult for anchylosis to take place, since they must be partially at least got rid of by some suppuration or other change before anchylosis can be secured.

When diseased, there is no joint, however, in which the changes can be better recognized, or the clinical evidence of disease in the synovial membrane or bones be made out with greater facility.

IN SYNOVITIS, acute, sub-acute, or chronic, the synovial sac becomes distended; the natural dimples or depression which in health exist on either side of the patella soon disappear, and in their places a bulging of the synovial membrane will be both seen and felt (Fig. 549). The patella, too, becomes pressed forwards, and, on palpation, may be felt to float as upon a water bed, and readily made on pressure to dip upon the condyles of the femur which lie beneath. The extensor muscles above the patella likewise will be raised by the distended sac, and the soft parts below the patella down to its ligament will project; distinct fluctuation not only being felt across the joint from side to side, but in an oblique direction from above downwards.

FIG. 549.



Appearance of knee-joint in synovitis.

Acute synovitis of the knee, except as a part of so-called rheumatic fever or pyæmia, is rarely met with, unless as the result of a wound or the extension of suppurating disease into the cavity. It is a most severe affection, and unless speedily arrested by ice, leeching, or those means suggested in the chapter on wounds of joints, ends in the destruction of the joint, and too often in the forfeiture of the patient's life.

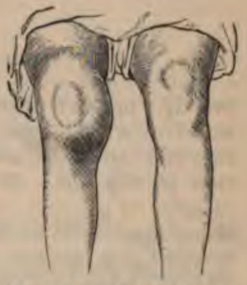
When, after suppuration, life is spared and the joint goes on to repair, anchylosis may be secured, and in puerperal, rheumatic, or pyæmic cases, this result is not rarely met with, the joint undergoing the whole series of changes in a few months. This subject, however, will receive attention in the chapter on the suppuration of joints.

In *sub-acute* synovitis, a far more common form than the acute, the local symptoms are the same, but the constitutional are far less severe, whether the disease be caused by some local injury or by some general cause, such as gout, gonorrhœa, rheumatism, or syphilis; it moreover almost always terminates in recovery.

To *chronic* synovitis the same remarks are applicable. This affection is often known as hydrops articuli or simple dropsy of the joint, the chief symptom being an excess of fluid. In many of these cases, however, this effusion into the joint is associated with other changes such as are known to exist in what is now recognized as a special affection—the *chronic rheumatic osteo-arthritis.* In it the joint becomes so stretched by the effusion, and the ligaments at last become so useless that the leg may be made to move about as a flail in every direction. In a large number, however, plates of bones will be found in the synovial membrane or about the articular ends of the bones, as well as bony outgrowths or fringes of ossific matter from the margins of the articular facets, together with other changes, to which attention will be directed in the proper place. It is well, however, to remember here, that a large number of the cases of chronic synovitis or hydrops articuli, are really examples of the peculiar disease known as rheumatic or osteo-arthritis.

IN THE ARTICULAR OSTITIS of the knee-joint the expanded bones are soon made out on comparing the sound with the affected limb, for the articulation thus affected acquires a special shape which is not to be misinterpreted, the condyles of the femur and head of the tibia assuming a globular form, the soft parts covering in the bones being healthy and movable, and no effusion existing in the joint. (Fig. 550.) At times, a joint so affected will become two inches longer than its fellow; when effusion is present, the extension of the inflammatory action from the bone to the joint itself is indicated, the case being clearly a more severe one.

FIG. 550.



Appearance of knee the seat of articular ostitis.

The condyles of the femur or head of the tibia alone may also be the seat of suppurative disease, of an acute or chronic abscess, these local bone abscesses being probably more common in the head of the tibia than elsewhere. Under these circumstances, the enlargement will be confined to the bone affected, until the abscess burrows into the cavity of the joint when the joint becomes inflamed. This suppuration may occur with or without necrosis. Fig. 562 illustrates a case in which diseased joint followed necrosis.

IN THE PULPY DISEASE of the synovial membrane, the local symptoms by which the affection is to be diagnosed are likewise characteristic. In typical cases neither expanded bones nor dilatation of the synovial sac with fluid is present, but the different points of bone which are always to be made out in a healthy joint, are obscured, if not undistinguishable; they are covered in with a soft solid, yielding on palpation over the articular ends of the bones, and more particularly around the patella, a doughy sensation. No fluctuation is to be detected, as a rule, and, when fluid exists, it will clearly be in a thickened capsule. At times, this pulpy thickening of the synovial membrane is a secondary affection, due either to some articular ostitis or to repeated attacks of synovitis. It may also occur as part of a syphilitic disease from the effusion of gummy material around the joint. What Collis described as syphilitic joint, I believe to be of this nature, viz., the pulpy disease, in a syphilitic subject, possibly complicated with periosteal thickening.

DISEASES OF THE ANKLE-JOINT.

Nothing particular is to be noticed in the diseases of this joint; their pathology is identical with that of all other joints, synovial mischief being possibly more common than affections of the bone. Effusion into the joint is readily detected by the swelling and consequent pressing forwards of the extensor muscles of the foot, by the fluctuation between the malleoli in front, and at times behind, and along the borders of the tendo Achillis. Bone enlargement is readily seen by the expanded malleolus or malleoli. Bone abscess may occur in either malleolus or in the astragalus.

The pulpy disease makes itself known by some such swelling as is found in synovitis, but the swelling will not be due to fluid, but to the presence of the lowly organized tissue found in the disease, showing itself in a doughy swelling around one or both of the malleoli and beneath the extensor tendons.

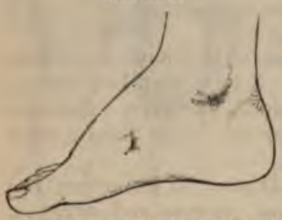
Disease of the Tarsal and Metatarsal Joints,

or, rather, of the bones and joints, are very common; for it is in the bones, as a rule, that the disease begins, the joints becoming involved secondarily. *Disease in the joint between the astragalus and os calcis may*, however, be found alone, and I believe that such disease is commonly the result of some lateral sprain of the ligaments that hold these bones together; lateral sprains of the foot being more likely to be felt at this articulation than at the ankle, as the astragalus is held so firmly between the malleoli. Disease in this joint is to be recognized by the swelling being *beneath* the malleoli; the pain produced by any lateral movement of the heel or foot; and occasionally by the grating of exposed bone. The movements of the ankle joint will be uninvolved.

Disease of the other tarsal or metatarsal bones is indicated by the enlargement of the bones, as well as by the position of the sinuses leading down to them. The scaphoid bone and joints are frequently affected, this bone being the keystone of the antero-posterior arch of the foot; and when so affected, the disease very commonly extends to the cuneiform bones, there being but one synovial capsule common to the scaphoid and the three cuneiform bones.

The form of the foot thus affected is very peculiar. "It assumes," writes Erichsen, "a remarkable bulbous or clubbed appearance; the fore part and dorsum of the foot are greatly swollen, glazed, and possibly perforated by sinuses discharging thin unhealthy pus." ('Science and Art of Surgery.') When diseased and dead, these four bones may be removed, and a good foot left. As a single bone, the cuboid is also not rarely diseased, and may be taken away without any detriment. In the case figured (Fig. 551) the scaphoid, three cuneiform, and cuboid bones were removed, and an excellent foot remained. I removed them from a boy, æt. 8, by simply enucleating the diseased and dead bones from their beds, and disturbing the periosteum and soft parts as little as possible.

Fig. 551.



Appearance of foot after the removal of the scaphoid, cuboid, and three cuneiform bones.

Of the **metatarso-phalangeal joints** that of the great toe is the one most frequently diseased, either from injury or otherwise, and when so affected, it is troublesome to deal with. There is some reason to believe that the bursæ about the sesamoid bones at the ball of the toe are occasionally the source of the evil.

When dead bone exists in these joints it may be removed, and in some cases the joint may be excised with a good result. I have done this on many occasions, and in several a movable joint was secured. *Gouty* affections of this joint are very common and may go on to disorganization. Disease of the joint as a result of a neglected bunion is not rare, but such cases will be treated of in another page.

Disease of the Pelvic Joints

is often overlooked or mistaken for hip or spinal disease, yet it has features of its own. It is more commonly met with in adults than in children, and after parturition than local injury, and is usually chronic. It may be secondary to disease of the bones that form the joint. In its early stage it is characterized by pelvic or gluteal pains which are aggravated by exercise, relieved by rest, and often put down as rheumatic. Lameness is generally present with a very peculiar, unsteady, rolling gait. Local tenderness will generally be manifested on digital pressure over the joint, and pain excited by separating or pressing upon the iliac wings, swelling along the line of joint may also be visible. The thigh may or may not be flexed, but it will be made to move freely when the pelvis is fixed. As the disease progresses, suppuration will appear either in the gluteal region over the sacro-iliac joint or in the pelvis, and when the thigh is permanently flexed, pelvic suppuration is indicated. It is to be distinguished from hip disease by the fact that there is free movement of the femur in the acetabulum when the patient is recumbent and no spasm of pelvic muscles. There is, moreover, no swelling behind the trochanter or pain on pressure in the part. In no stage of the disease will there be any shortening of the limb.

In the treatment of this affection, the same principles are applicable as in other joints—rest, tonics, good food, and air being essentials. As soon as suppuration can be made out, an incision should be made to prevent burrowing; and when dead bone is present, it should be removed. I have taken away large pieces of bone from this joint with great benefit.

Disease of the symphysis pubis is very rare, and I have seen it but twice. One of the cases was in a man, who some months before coming under my care was believed to have fractured his pelvis and lacerated his urethra. When I saw him, sinuses existed running down to and into the joint, but no dead bone could be felt. In Guy's Museum there is a preparation, 1314^{50}, in which the synchondrosis is ossified and carious; and a second, 1314^{40}, in which complete anchylosis is present with new bone.

Disease of the coccygeal joint is at least as rare as that of the pubic, although well-marked cases have been recorded. It can readily be made out by thickening over the joint, and pain produced by any movement in the bone; in some cases a distinct grating can be felt with the finger in the rectum on attempting to move the part.

When the disease is clearly established and the joint disorganized the best practice is probably the removal of the bone; and, when this is not advisable or practicable, the coccygeal muscles had better be divided by a subcutaneous incision to give rest to the joint, but under these circumstances, the cure must be slow. The pains of sacro-coccygeal joint disease are much simulated by what Sir J. Simpson described ('Med. Times,' 1859) as coccydynia, which is met with in women when any of the coccygeal muscles are brought into action by walking, running, rising, defecating, or sneezing. This affection may be cured by the subcutaneous section of the coccygeal muscles.

Diseases of the Joints of the Upper Extremity.

Diseases of the sterno-clavicular joint.—Suppuration of this joint in pyæmia is common, though as an independent disease it is very rare. I have seen but two examples of it, which ended in disorganization. In syphilitic subjects, however, inflammation about the joint is not unfrequent, but such cases rarely suppurate. The disease when it occurs is easily recognized, the joint being superficial.

Disease between the sternal segments has been recorded by Hilton. I have seen but two examples of it, and both were complicated with sub-sternal abscess and necrosis. Local pain increased on pressure, and the movement produced on coughing, with swelling, indicate the disease.

Diseases of the Shoulder-Joint

are comparatively rare, and form a very small proportion of the joint cases admitted into a hospital, the majority of such cases being treated outside. Synovitis, however, in all its forms, is found in this joint as well as cases of articular ostitis, &c. The joint has no special disease.

When disorganization and suppuration take place, the matter burrows down the bicipital groove and generally makes its appearance in front of the insertion of the deltoid muscle; at times, however, it bursts posteriorly or burrows beneath the pectoral muscle.

If recovery takes place with anchylosis, a wonderfully useful limb is often secured, the scapula allowing an amount of movement which is sufficient for most of the duties of life, though it rarely admits of any overhanded action. When disease takes place at the junction of the upper epiphysis and shaft, and suppuration follows, the abscess burrows in the same way, and much difficulty may be experienced in the diagnosis of the case, although the thickening about the neck of bone under these circumstances is generally greater than in joint trouble. When inflammation of the bursa placed beneath the deltoid muscles exists, some of the symptoms of shoulder-joint disease are present, but the fact that the least action of the deltoid muscle excites pain in bursal disease when the movement of the arm by the surgeon does not, and that the joint moves freely although possibly attended with a sense of crepitation, ought to suggest its nature.

Diseases of the Elbow-Joint

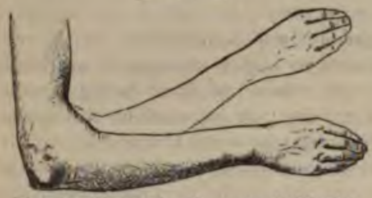
are of great importance, as the value of the hand is greatly dependent upon the integrity of the elbow, and a stiff elbow-joint is a serious detriment. In their general pathology they are the same as any other joint.

Synovitis makes itself known by the general enlargement of the joint, as well as by the sense of fluctuation on either side of the olecranon process. Pulpy disease is recognized by the presence of the doughy, semi-fluctuating products that have been poured out in the same position. Articular ostitis can be recognized by the expanded bones.

In a general way, elbow-joint cases do well, recovery taking place with movement, in the majority, while in the minority, a natural cure takes place by anchylosis, with or without external suppuration.

The amount of movement that may at times be secured after a natural recovery from a suppurating joint is very good. Fig. 552 was taken from a boy æt. 19, who had had a disorganized joint treated by free incisions when ten years of age. In it the head of the radius was displaced outwards. He had as much movement as the drawing indicates. In many cases, useful flexion and extension are often secured as well as pronation and supination, and in some while these latter movements are preserved, the ulna and humerus are firmly fixed together, and when so, the value of the hand is but little diminished. In several of my own cases, I have found after many years the rotation of the radius perfect.

Fig. 552.



Drawing illustrating the amount of flexion after recovery from suppuration.

But as these good results which may follow a cure by natural processes cannot be calculated upon, it is doubtless a wiser course to submit the majority of cases of disorganized elbow-joint to operative interference, not so much probably to remove a disease that is incurable by natural processes, as to procure movement and prevent anchylosis.

Disease of the Wrist-Joint

is not so common as that of the carpal bones and carpo-phalangeal joints, and when it has started in one of these parts is very prone to be propagated to others. When suppuration takes place, the pus often burrows freely between the tendons, but as long as necrosed bone does not exist to prevent recovery, a good result may be looked for, although probably with some amount of stiffness or even anchylosis. When necrosed bone keeps up the irritation it should be removed. To assist recovery the hand should be secured by a splint in the position intermediate between pronation and supination, such an one being the best. When the hand is left alone it is too apt to assume the prone position—a by no means good one.

Disease of the Radio-ulnar Joint

is rarely met with. In a recent case of a middle-aged man that came under my care, it appeared to follow over-action, and gave rise to severe local pain and general disturbance. It was followed by suppuration and relieved by a free incision on the dorsal aspect of the wrist down to the joint. The case terminated by anchylosis.

Diseases of the Phalangeal Joints

are, in their nature, like those of other joints, and must be dealt with upon similar principles, synovitis, pulpy disease, and bone disease, with or without disorganization, being found in all. When the disease is confined to the synovial membrane, and the joint has not disorganized a recovery with movement may be secured by good treatment. When a natural cure by anchylosis only can be looked for, the question of the removal of the finger may be entertained as a matter of expediency, for a stiff joint at the metacarpo-phalangeal joint is a serious detriment, while at the middle joint it is less injurious, and least so at the terminal one.

In the thumb, amputation is rarely to be thought of, for when recovery from disease of the distal phalangeal joint is probable by anchylosis, a good thumb may be secured, though the same result in the metacarpo-phalangeal joint is so inconvenient that the operation of excision is probably preferable. But every case must be treated on its own merits and according to its own special wants.

The position of the patient, his occupation, age, &c., should have a powerful influence in guiding the surgeon to a decision.

ON THE TREATMENT AND CURE OF JOINT DISEASE.

In the treatment of joint disease the most important point a surgeon has to bear in mind is its curability, since clinical experience affords convincing evidence that, under judicious management, a large proportion of joint cases can be guided successfully to a complete recovery, and that while in some a cure can only take place by anchylosis or a stiff joint, it is in exceptional cases only that severe operative interference is required.

The recollection of these facts is a constant encouragement to the surgeon to persevere with, and to the patient to submit to, the necessary means adapted to secure these ends; while it in no way tends to discourage operative interference, when the course, nature, or severity of the disease affords sufficient evidence that such interference is expedient or necessary.

All pathological evidence tends likewise to the support of these conclusions, for no one can have carefully examined joints that have been removed by either excision or amputation, or others that have failed to go on towards a successful issue, without being struck by the vast amount of repair that exists side by side with the disease, and by the apparently limited character of the latter, and without feeling in many cases where a capital operation had been performed that simple operative interference would probably have been successful, or that none at all was really required.

At the same time it must be borne in mind that while in a pathological sense disease may need no interference, on account of its limited nature or reparable character, yet, in a clinical aspect, a very opposite conclusion may reasonably have to be drawn; since the disease by its progressive and weakening tendency may have demonstrated that the powers of the patient were incompetent to provide, even in limited disease, the stimulus needed for repair.

In the treatment of joint disease, however, it is not always a question as to the possibility or impossibility of securing a successful issue by simply aiding natural efforts, since questions of expediency come before the surgeon as to the wisdom of making the attempt, or as to whether better results might not be secured by surgical interference.

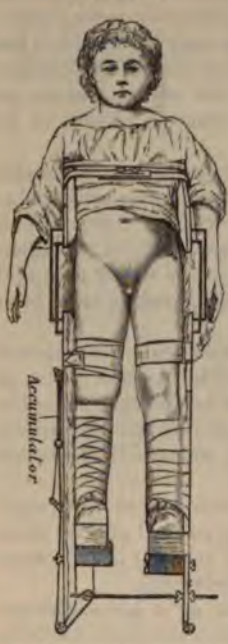
Surgeons, moreover, who look upon a stiff elbow- or shoulder-joint as a serious inconvenience and an unsatisfactory result of treatment, consequently advocate early excision of a joint with the view of obtaining movement; and those who have little belief in natural processes guided by art, bringing about anchylosis in disease of the knee, or who think that the time occupied in the attempt is badly spent, advocate a like practice. While some surgeons are always satisfied with a cure of the disease by natural efforts assisted by art, and remove by operative measures joints or parts of joints when these natural processes have proved themselves incompetent to effect a cure; others maintain that in a large number of cases these natural processes lead only to an undesirable end, and that it is not expedient to trust to them. Arguments of expediency also are used, and in recent times have gained in importance, more particularly as brought to bear upon the question of a cure with a stiff joint, when a prolonged interval of time must of necessity be required to secure the end. In some cases, such arguments are of weight, and worthy of consideration, although as a broad rule of practice it is dangerous to adopt them, for, in the majority of cases, natural processes guided by art are followed by results which leave little to be desired, and are secured without the risks which are attached to all operative interference. These points, however, will come out better when the treatment of individual joints has to be considered, and to which attention will now be drawn.

TREATMENT OF DISEASE OF THE HIP-JOINT.

So long as suppuration or other disorganizing change in the joint has not appeared, a good hope of a recovery with a useful articulation may be entertained; and so long as the disease is in the synovial membrane, the probabilities of a recovery with a movable joint are great. In a large number of cases where time has been allowed to pass and disease has gone on to produce degenerative changes in the articular cartilages, recovery with anchylosis is to be looked for; anchylosis without suppuration being more common after articular ostitis than after synovial disease (*vide* paper, by author, in 'Med. Times,' July and August, 1869). When, however, disease originates in the epiphysis of the head of the bone—or in the epiphysial connective cartilage between the epiphysis and shaft, the prospects of a recovery with movement are slight, unless the mischief be checked in its early stage; for, in the former case, the articular cartilage which derives its nourishment mainly from the bone, soon undergoes degenerative changes that can only be repaired by processes ending in anchylosis; and, in the latter, the epiphysis is often cast off as a foreign body, when recovery can only take place on its exfoliation or removal.

In both classes of cases, however, the treatment is in a measure the same—that is, the joint is to be at rest, and all interarticular pressure is to be avoided, for "in diseases of the

Fig. 553.



Double splint as applied in disease of the right hip-joint.

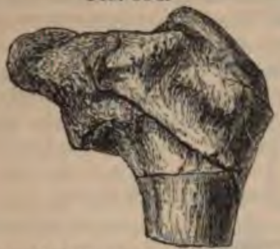
joints *rest* cannot be two much insisted upon" (John Hunter, 1787); and for these ends the application of a splint is essential, that form of splint being the best which keeps the joint quiet, the pelvis at its normal angle to the spinal column, and the affected limb from being either adducted or abducted; without doubt, these points are best preserved by the double splint figured in 510, 553. Children with this splint well adjusted can be moved with the greatest facility, and, even when there is acute joint disease, with very little suffering. Sir C. Bell clearly saw the necessity of rest, and was so impressed with it as to make the following ingenious suggestion: "I have observed that patients who have hip disease recover when anchylosis of the joint takes place, when the bones become fixed and immovable. Founding upon this, I attempted by various contrivances to form an instrument which might keep the bones at perfect rest, but so great is the tendency in this joint to motion, that I have never yet succeeded. No instrument has ever been effectual in keeping the thigh and trunk fixed." "I have been led to think that an operation might be performed here; *that a cut might be made to expose the upper part of the femur*, and the *neck be sawn through*: not, you will observe, to take away the head of the bone, as done by Mr. White with success, *but to permit it to remain at rest* and to form an adhesion with the acetabulum. In this case a joint will be formed where the bone has been divided" ('Lond. Med. Gaz.,' Jan. 12, 1828, "Hip Diseases," by Sir C., then Mr. Bell.)

When *suppuration has appeared*, recovery with anchylosis can alone be looked for, though where diseased bone exists this result cannot be expected, unless the diseased bone is cast off or removed. When, however, an abscess has been the result of chronic changes in a pulpy synovial membrane, the complete disorganization of the joint need not, as a necessary consequence, be contemplated, although where it has followed disease in the articular extremities of the bones (articular ostitis), it is more than probable that the articular cartilages with the ligaments and synovial capsule will have been completely destroyed. Under the former circumstances, therefore, when the suppuration has taken place as a consequence of synovial disease, recovery may ensue with soft or fibrous anchylosis, or even some degree of movement; whilst under the latter, though fibrous anchylosis may supervene, osseous anchylosis can only occur after the cartilages with the articular lamellæ of bone have entirely gone, and there is no necrosed bone left to keep up the disease; for, with this complication, a natural recovery cannot take place till the source of irritation has been discharged by natural processes, or, removed by art.

When, therefore, suppuration occurs in a hip-joint, though recovery may follow with partial movement, there is but one result a surgeon can reasonably look for and strive to secure, and this is anchylosis; and if by the history of the case and the clinical symptoms he can make out that the disease began in the synovial membrane, and that the suppuration was the result of pathological changes in that tissue alone, the hope of securing this result is very good; for the disease in the joint, under these circumstances, however extreme it may be, is probably only superficial, and does not involve the bones to any extent, so that a good recovery with a stiff joint may fairly be anticipated. If, however, the history of the case and the clinical symptoms indicate disease of the bones, the probabilities of the same result taking place will rest upon the amount of the disease, and if the disease in the bone be superficial, a natural cure by anchylosis may be looked for; since dead bone, if not too large, and even the epiphysis, may be discharged externally, and a good recovery follow. When, however, the disease in the bone is extensive (Fig. 554), or a sequestrum is so placed in the centre of the bone as to keep up irritation and interfere with repair, as is shown in Fig. 536, the surgeon's active interference will be imperatively demanded, and it may be added, that it is never practised with better results.

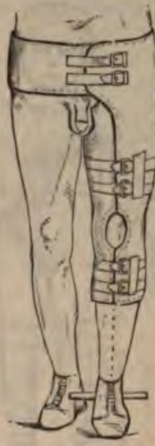
Under all circumstances, however, the first point in treatment is, to secure the complete immobility of the limb, which can be insured by splints; extension should likewise be kept up by means of weights or elastic forces. In one case a long outside splint may be enough, while in another the weight is sufficient. In very chronic cases an immovable casing of leather, gutta percha, felt, wire, perforated zinc, or other appliance, such as the fancy or

FIG. 554.



Head of femur altered by disease—removed by excision. Prep. 1318^{80}.

FIG. 555.



Immovable casing for hip disease.

ingenuity of the surgeon suggests, is the best; absolute immobility of the joint, prevention of inter-articular pressure, tonic treatment, liberal regimen, good air, and time, being essential conditions for a successful issue. Fig. 555 represents a good apparatus to insure immobility when the patient is in bed, though the double splint figured 553 is better; for with it abduction and adduction of the affected limb are prevented, the pelvis is fixed at a right angle to the spinal column, and the external malleolus of the affected side is kept in a line with the hip, elastic extension being maintained through an accumulator over a pulley inserted in the cross foot-piece. Mr. C. De Morgan's long splint (Fig. 518) is also good, applied to the side of the sound limb, through which he likewise applied all counter-extension.

When mal-position such as arises from flexion, abduction, or adduction of the thigh exists, a position which would be detrimental to the patient's welfare, it is essential that it should be remedied before the plan of treatment already laid down is carried out, and so long as no anchylosis has taken place, or the union is soft, there is a good prospect of this being effected. For this purpose, chloroform should be given, and the thigh slowly but surely brought to a straight line with the body, and there fixed; any inflammation caused thereby being checked by the local application of ice or hot fomentations, according to the comfort one or other gives the patient. At times, however, active disorganizing changes and bad results follow. When displacement or dislocation of the joint exists, it is often in the surgeon's power to reduce the dislocation, and then to treat the case as one of the ordinary kind. In the case from which Fig. 556 was taken, the boy was eleven years old; the disease had been acute, and the dislocation was on the ilium. Its reduction was readily effected under chloroform, and a good result followed. A weight of six or seven pounds was enough to keep the limb in position, and the counter-extension was well applied on the opposite side of the pelvis. If, however, I had now the treatment of this case, I should have employed the double splint with elastic extension.

When the displacement is of long standing and the natural cure of the disease has gone on to its end, it is not wise to interfere and thus run the risk of undoing what nature has well done; as many of these cases of supposed dislocations are not of this kind, but simply a shortening of the neck of the bone from the absorption or destruction of the head or epiphysis of the femur, or, at times, of the acetabulum. Drs. March and Sayre, of New York, deny the existence of a dislocation, but in this they are wrong. It does occur, although rarely. In the case from which Fig. 556 was taken, it was very clear.

In exceptional instances the displacement of the limb is due to a separation of the neck of the bone from the epiphysis, which is left fixed in the acetabulum, or is cast off. This condition is illustrated in Fig. 540–1.

When anchylosis has taken place at a bad angle, at such an angle as seen in Fig. 557, any attempt at forcible flexion with the view of breaking down the adhesions, must be looked upon as futile and unjustifiable, although it may be right to consider the propriety of improving the position of the limb by some surgical procedure; and for this object, several surgical operations have been devised. Thus, in 1875, M. Tillaux presented before the Surgical Society of Paris a woman, æt. 32, the subject of bony anchylosis of the hip-joint of a year's standing, the limb having been flexed and rotated inwards, for whom he had, with success, *forcibly fractured the neck of the bone.* He effected this when the woman was under chloroform by using considerable force, the bone giving way with a loud crack. He subsequently treated the case as one of fracture, and at the end of two months the patient had a straight limb. M. Tillaux described the result as *splendid*, and considered the practice infinitely preferable to the operation of subcutaneous section of the neck of the bone. The operation is, doubtless, of value in certain cases, and wort of consideration.

FIG. 556.

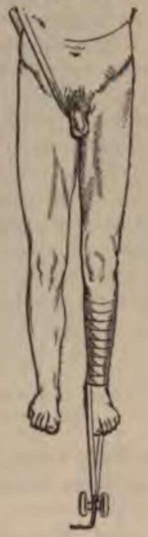
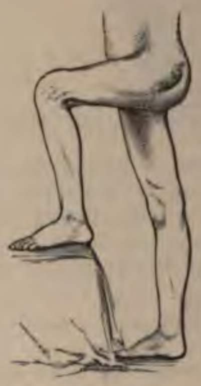
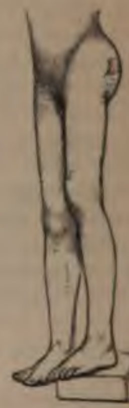


FIG. 557.



Anchylosis of hip-joint, with femur at right angles to pelvis, before operation. Case of boy, æt. 15.

FIG. 558.



Position of the limb after Adams's operation as performed by author.

In 1869, Mr. W. Adams ('Brit. Med. Journal,' 1870) successfully treated a cas this nature by subcutaneous division of the neck of the thigh bone by means of a saw, and up to October, 1876, twenty-two operations of the kind had been performe five by Mr. Adams, four by myself, and others by Messrs. Jessop, Jowers, Jordan, L of Manchester, Sands, of New York, Golding-Bird, and others. The operation successful in twenty.

I look upon this operation with much favor, and believe it to be the best when femur has a neck to be divided.

The instruments required for the operation are such as those figured below (Fig. 5 The operation itself I give in Mr. Adams's words: "I entered the tenotomy knife a l above the top of the great trochanter, and carrying it straight down to the neck of the thigh-bone, divided the muscles and opened the capsular ligament freely. Withdrawing the knife, I carried the small saw along the track made—pursuing this by pressure of the fingers—straight down to the bone, and sawed through it from before backwards, in the direction represented in Fig. 560, which shows the saw applied to the anterior surface of the neck of the bone. The section of the bone was accomplished in four minutes. No hemorrhage followed, and a good recovery took place with a stiff limb." When the saw is used, it should be held at an angle of 135° to the line of the shaft of the femur (Fig. 560). A narrow chisel, however, is an equally instrument for the purpose.

FIG. 559.

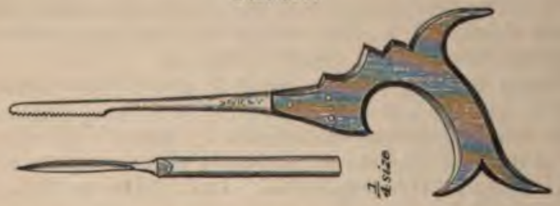
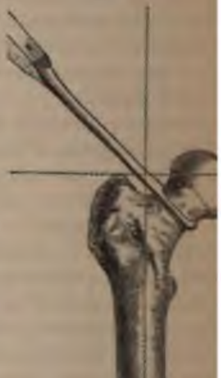


FIG. 560.



Drawing showing the section of the neck of the bone in Adams's operation

In my four cases the neck of the thigh bone was readily divided in less than five min and the wound above the trochanter healed in a few days; the boys walking in weeks.

I did not attempt to obtain movement in any, being well satisfied with the results secured; although before I operated on the last, I was alive to the fact that my friend Mr. Lund, of Manchester, had operated with such success upon a man who had both hip-joints anchylosed in a straight line with the body, and, as a consequence, could not sit, that after the operation excellent motion was obtained in each hip-joint, and the man could sit up in a chair with the body nearly perpendicular, and the thighs comfortably placed on the seat; he could moreover support the weight of the body upon the legs. ('Brit. Med. Jour.,' Jan. 29, 1876.)

When there is no neck of the femur to be divided, or the muscles and soft parts about the minor trochanter of the bone are so contracted and rigid as to render it probable that the shaft of the femur cannot be brought down to a right line, Gant's operation ('Lancet,' Dec. 1, 1872) should be performed; that is, the femur should be divided by a small valvular wound subcutaneously below the trochanter, either by means of the saw as employed by Adams, or chisel as suggested by Volckmann and advocated by Maunder, the same care to exclude air being employed in the operation as has been advised in Adams's. Both these operations are superior to Barton's, who divided the femur between the trochanters, and to Sayre's, who excised a wedge of bone from between them.

THE TREATMENT OF DISEASES OF THE KNEE-JOINT.

This may be taken as a type of the treatment of all joint diseases.

Acute synovitis is usually the result of a wound, and should be treated according to the principles laid down in a former page, viz., by rest and ice locally and opium internally. When disorganization of the joint ensues, few cases are more serious in their local as well as their general effects, as life is often endangered, and recovery with a stiff joint must be regarded as favorable. When the disease is the result of septicæmia, or rupture of an abscess into the joint, the success is no better.

In subacute and chronic forms of synovitis, a good result may, as a rule, be promised, and the treatment must be regulated by the cause of the disease. In traumatic cases, the local application of cold or warmth, according to the amount of comfort one or other affords, and keeping the limb immovable by means of splints, are the best means to use; and gentle support, by means of well-applied strapping, is a valuable adjuvant when only a relaxed condition of joint remains.

In other cases, the application of a blister to either side of the joint as well as the internal administration of the iodide of potassium, with or without bark or quinine, according to the necessities of the patient, are of great use. When gout appears to be an element in the affection, it is advisable to administer colchicum, lithia, and other remedies approved in that disease. When the case appears to have a rheumatic origin, alkalies, such as the bicarbonate or citrate of potash, etc., may prove serviceable; and, when there is any reason to suspect a syphilitic taint in the constitution, it is necessary to employ such treatment as is peculiar to such diseases, viz., the iodide of potassium or sodium, or some mercurial.

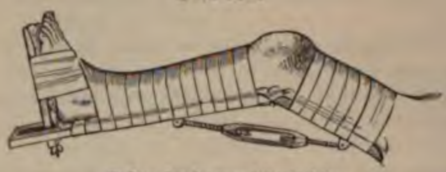
In very chronic and obstinate cases, paracentesis of the joint by means of the *aspirator* may be performed, and, in the hands of some, has been employed with marvellous success. Sir J. Fayrer was one of its strongest advocates, having shown ('Indian Med. Gaz.,' 1869) that in the chronic and subacute forms, much good is often obtained by the operation, if care be taken to exclude the air by carefully closing the puncture and fixing the joint on a splint; the drawing off of the fluid affording instantaneous relief. I have performed this operation on many occasions with good results when the tension of the joint was extreme; it is a practice, however, that ought to be followed with extreme caution.

The *pulpy disease* of the synovial membrane is a very obstinate affection, and though fairly curable with a movable joint in its early stage, and occasionally so in a later, is always tedious and unsatisfactory.

In its treatment, the absolute immobility of the joint is most essential. This may be guaranteed by the application of a well-adapted splint (Fig. 561), reaching from the foot two-thirds up the thigh. As long as any heat or periodic flushing of the joint exists, the limb must be kept raised, and warm moist applications applied by strips of lint surrounding the joint. After these symptoms have subsided and the products of inflammation alone remain, well-applied pressure, by means of strapping, is of great value. Mr. Marshall ('Lancet,' May 25, 1872) speaks highly of the five-per-cent. solution of the oleate of mercury in oleic acid as an application, and my experience of its use has been satisfactory. Blistering and firing in this affection seem to be of little value. In the very chronic stage of the disease, the Bavarian flannel splint (Figs. 479, 561A), or some other good casing, may be employed.

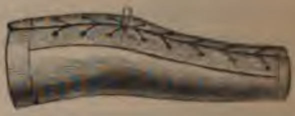
The constitutional treatment in all stages of this affection is essentially tonic, as the subjects of it are always feeble and often strumous; iron, quinine, bark, cod-liver oil, good food, and fresh or sea air are essential elements of successful treatment.

FIG. 561.



Splint for diseased knee-joint.

FIG. 561A.



Bavarian splint as completed for disease of the knee.

By these means, so long as suppuration has not set in, a cure may be effected, although many months may be required for its attainment.

When suppuration appears, the same principles of practice are applicable. When small deposits of pus form from the breaking down of some portion of the pulpy tissues, and make their way externally towards the skin, and not into the joint, they may be evacuated, and a good result still ensue. But when the joint becomes disorganized from the same cause, questions arise as to the expediency or possibility of saving the joint, but this subject will claim attention in the chapter on suppurating joints.

In articular ostitis, a disease readily made out in the knee, when simple expansion of the bones (Fig. 550), and an aching pain and heat are the local symptoms, all walking or standing should be positively interdicted; everything like inter-articular pressure forbidden; and fomentations of warm water applied two or three times a day, or strips of wet bandage covered by a handkerchief of elastic tissue or oil silk kept round the joint. Some speak highly of blisters, moxas, and counter-irritants, which I rarely employ, having long found the above practice preferable.

When heat has left the joint, the aching, miscalled "growing," pains disappear, and clinical evidence tends to show that all inflammatory action has subsided—the results or products of inflammation alone remaining, local pressure as applied by strapping not only gives comfort to the patient, but appears to help the absorption of the inflammatory products and the subsequent cure of the disease.

Constitutional treatment, however, must not be forgotten, and tonics, as a rule, are needed; cod-liver oil, combined with the syrup of the phosphate or iodide of iron, being a suitable prescription for children. When the appetite is bad, quinine may be given; at other times, iron, or other tonic. Good food and good air are as necessary in this as in all other joint cases. The use of the iodine evaporating box should not be omitted. Mercury is unnecessary.

In the early stage of articular ostitis, splints are not required, as the joint is not itself diseased, and passive movement of the articulation will not do harm; all inter-articular pressure, however, should be avoided, and for this purpose, extension by means of weights or elastic extension is very valuable. In a more advanced stage, however, when the disease has so progressed in the bones as to have set up some degenerating process in the cartilages, and the synovial membrane has become involved, as indicated by effusion or the pulpy synovial thickening, the use of the splint is essential.

In neglected cases when the joint has been allowed to assume an abnormal position—the most common being that of flexion, with some amount of rotation inwards or outwards—and in still worse cases where dislocation of the tibia and fibula backwards has taken place, the deformity if possible must be remedied by gradual extension. This should be employed by means of a posterior screw splint, or the application of a constant gentle force, exerted through one of the many instruments that have been made with the view of pressing the femur backwards and the head of the tibia forwards. Manual extension exerted under chloroform employed with care rarely does much harm; forcible and sudden extension cannot be recommended, as it is followed at times by severe local action and suppuration. In exceptional cases it may be required.

Anchylosis.—When a knee-joint has to be fixed, the best position is one of slight flexion, or that which a man naturally assumes when he stands at ease. But anchylosis is more difficult to secure in the knee than any other joint, on account of the presence of the inter-articular fibro-cartilages which prevent the bony surfaces from coming in contact.

Moreover, these cartilages when diseased are most difficult of repair, no tissue undergoing a reparative process more slowly or imperfectly. It is, doubtless, from a knowledge of these clinical truths that some despair of securing anchylosis in the knee, and even doubt its occurrence, and are led to interfere by operation oftener than others. Anchylosis of the knee—good solid ossific union of the bones, as well as fibrous anchylosis—does, however, occur, and when secured, is of great value. It gives a limb which is far superior to any other that follows excision, and is, as a rule, obtained without the dangers of an operation, although possibly with the expenditure of more time. I have the notes of many such cases, and in the 'Med. Times,' 1870, I published a series in some of which this result took place with and in others without suppuration.

Diseases of the ankle-joint should be treated on precisely the same principles as those laid down for the knee, the best position of the foot being at an angle slightly exceeding that of a right angle.

Diseases of the shoulder-joint, in their progress and treatment, are very similar to those of other joints. When the shoulder has to be fixed, a leather casing, including the scapula and humerus, is a good apparatus, the elbow being at the same time supported. The arm should be allowed to hang parallel to the trunk, with the elbow slightly away from the chest; and for this purpose Stromeyer's cushion is of great value. (Fig. 500.)

Diseases of the elbow-joint can be usually managed with greater ease than any other—a splint applied in the flexure of the joint, passing well down to the hand to keep the radius in a position intermediate between pronation and supination, being the best. If the hand is left unsupported it is certain to assume the prone position, which, as a rule, is undesirable. Dislocation of this joint, except at the head of the radius, which is often displaced backwards and somewhat outwards, rarely takes place as a result of disease.

Before fixing the joint at an angle, it is well in most cases to consult with the patient, for in some, the straight position is the more desirable. In the case of a painter I had under care, a flexed elbow would have lost him his occupation. In another, of a bargeman, the joint was fixed at a right angle, with the hand pronated, to hold the oar. A carpenter asked me to fix his left elbow at an obtuse angle, and a haycutter nearly straight. In all these instances, any other position would have been most detrimental.

In disease of the *wrist* and *carpus*, the same position of the hand should be maintained as in disease about the elbow.

In disease of the *phalangeal joints* when anchylosis is to be obtained, I have of late years always fixed the diseased extremity at such an angle as will allow its point to come in contact with the top of the thumb, having invariably found the straight positions of the finger very inconvenient. In this position, the fingers are more useful and less in the way, and the deformity less observed. In these cases, the best material to use as a splint is a piece of zinc or tin, which is firm, thin, and takes up little space.

ON OPERATIVE INTERFERENCE—EXCISION AND AMPUTATION IN JOINT DISEASE.

In the treatment of joint disease, next to the preservation of life, the aim of the surgeon is to preserve the natural movements of the articulation; and when that hope has gone, to save the limb. If this end can be obtained with a stiff joint, the result in disease of the lower extremity may be regarded as satisfactory, and even in the upper, a stiff shoulder or elbow-joint at a useful angle, is not so bad a result as some would lead us to believe.

When neither of these ends appears probable, possible, nor expedient, from the extent of the local disease, the general want of power of the patient, or the necessities of the individual case, the question of operative interference comes before the surgeon, and he has to decide on the expediency of an incision into the joint, the removal of dead bone from or excision of the joint, or amputation; and to work out the many points involved in the solution of these questions is a task of difficulty, since, from joints having a different value in the human body, a form of practice which is applicable to one may be inexpedient to another. This difficulty, moreover, is doubtless aggravated by the different value which surgeons place on different forms of practice, and the estimation in which they regard natural processes; for one who has great faith in natural processes in the cure of disease, and particularly of joint disease, will attempt to save a limb that another will condemn, since he regards any practice as wrong that interferes with a natural recovery so long as any reasonable hope exists of securing such a result; and believes that a cure by anchylosis, however acquired and however long a time may be passed in securing it, is worth the attempt. Another, who has stronger faith in surgical treatment, will excise a joint, believing it to be inexpedient to attempt to obtain a natural cure, even if it may be gained, when by excision an equally good if not better result can be secured in a shorter time. And a third looking upon both forms of practice as too protracted and uncertain, will remove the diseased parts by amputation, under the conviction that a more certain result as well as rapid recovery will be secured by such a process.

To lay down any definite rules upon operative interference in joint disease generally, is consequently an impossibility, since each joint has its own surgery.

It may, however, be stated as a starting point, that no surgical operative interference is justifiable, unless a joint has suppurated or become disorganized; and that amputation should only be thought of when all minor measures are inapplicable, and it is necessary to remove the disease to save life. The larger the joint the greater the dangers of operative interference.

THE TREATMENT OF SUPPURATION OF THE HIP-JOINT.

In the treatment of a suppurating hip-joint as of any other, it is most important to insure a free vent for all discharge, as pent-up matter is always injurious, and with this view a free incision into an abscess connected with the hip, or the free opening of a sinus through which pus slowly flows is sound practice. In the residual abscesses of repairing joint disease, it is well, however, not to incise unless they show a tendency to increase, since many often dry up spontaneously. When interfered with, the pus should be drawn off with the aspirator.

ON THE REMOVAL OF NECROSED BONE FROM AND EXCISION OF THE HIP-JOINT.

When in a suppurating hip-joint the presence of dead bone can be made out, there can be no question about the propriety, nay, necessity for its removal; and if this can be effected by means of a free incision, nothing more is needed; when the os innominatum is involved, there is no reason against the removal of the sequestrum, since it is certain that so long as dead bone remains to keep up irritation, a cure by natural processes is impossible. An operation undertaken upon the hip-joint, under these circumstances, is scarcely more than any severe operation for necrosed bone, and in all probability is not more dangerous. The joint as a joint has to a certainty disappeared altogether, and a free incision into it will hardly add to the dangers of the case. In a large number of cases, however, this cannot be done, and under such circumstances, when a cure by natural processes cannot be looked for, the best practice lies in excision of the head of the femur, and, if the acetabulum is superficially affected or stripped of its cartilage (the disease being probably secondary to that in the femur), it will undergo a natural repair as soon as the cause of its disease has been removed.

When the presence of dead bone cannot be made out, or the weight of evidence tends to show that there is no such complication to interfere with a natural recovery, it is still a disputed point whether excision of the head and neck of the femur is a necessary or even justifiable operation. Those who argue against its adoption assert, and with some truth, that while all these cases of hip disease are capable of a natural repair in patients who have good or even tolerable reparative powers, yet in those who have not, the operation of excision must naturally fail, since as much power is probably needed to effect a cure after excision as is demanded for the natural repair of an uncomplicated suppurating or disorganized joint.

To these latter remarks, however, I am disposed to demur, and while ready to admit, that in all cases of disorganized hip-joint in which there is no disease of the bone to interfere with recovery, a natural cure may be fairly looked for, so long as the powers of the patient keep up, and no signs of failure make their appearance; yet when these signs show themselves, or evidence is adduced that in the battle of disease the reparative are weaker than the morbid processes, and treatment fails to turn the scale in their favor, the expediency of performing excision becomes an open question, which facts must decide; although I may at once admit that I believe the operation under such circumstances, to be not only justifiable but highly advisable. The removal of the source of irritation acts beneficially upon the patient, and many a case has, after the operation of excision, gone on to recovery, which unoperated upon would have eventually proved fatal, the patient being worn out by suppuration and exhaustive efforts to repair.

For facts in reference to excision of the hip-joint, I have resorted to Hodges's work, and also to a recent paper by Dr. R. R. Good, of Kentucky; the former giving us a statistical table of cases up to 1861, and the latter from 1861 to 1868. Hodges supplies 111 cases, 56 of which recovered, and 55 died. Good quotes 112 cases, 52 of which recovered, and 60 died; a little more than half of the whole number of cases thus proving fatal. I have lost four out of twenty cases, and although I cannot say that in the sixteen surviving, all had useful limbs, I am within the truth when I assert that the majority had; while without the operation recovery was impossible.

Mr. Holmes, too, in his excellent work on 'Children's Diseases,' gives us 19 cases, of which, in a general way, one third died from the operation, another third recovered with useful limbs, and the remaining third, although not recovering, derived great benefit from the operation.

On analyzing these cases as to the influence of age upon the operation, some valuable facts may be recorded, and out of 46 of Hodges's cases operated upon under ten years of age, 15 died, or 33 per cent.; of 37 cases between eleven and twenty years of age, 21 died, or 57 per cent.; of twelve cases operated upon between twenty-one and thirty years of age, 7 died, or 60 per cent.; and of 6 cases operated upon over thirty years of age, 5 died, or 83 per cent. The analysis of Good's cases indicates the same truths, for of the cases operated upon under twelve years of age, 40.6 per cent. died; between twelve and twenty years of age, 60 per cent. died; and between twenty and fifty-eight years of age, 76 per cent. died.

Excision for hip disease in young life, therefore, is by no means a fatal operation, two out of three recovering; while from ten to thirty years of age, something less than half recover, but after that period it is full of danger. The operation of excision, like amputation, lithotomy, or any other great operation, is more dangerous as age increases. The important fact that children beyond infancy bear severe operations well should ever be before us, though it is of equal importance to remember, that it is in young life we meet with the best success in the treatment of hip-joint as of other disease.

With the fact, therefore, before us, that in selected cases, excision of the head of the femur is not only a justifiable but a good operation, let us briefly consider under what circumstances it should be performed, and, from the general facts, as learned from statistics, we find two great results come out clearly: That in childhood the operation is attended with success, two patients out of three recovering, while in adult life it is attended with great danger, at least two out of three patients dying. In the former case, consequently the operation may be entertained under circumstances which in the latter would render it unjustifiable. When, then, should excision of the hip be performed? And, first of all, when should it not?

It should certainly never be performed where suppuration or disorganization of the joint has not taken place; because so long as this condition is kept off by surgical as well as by medical skill, a solid hope exists that a cure of the disease may be secured, though by anchylosis.

It should not be performed when all evidence tends to show that the bonds entering into the formation of the joint are neither extensively involved nor wholly or in part necrotic, and where the general condition of the patient under proper treatment is fairly maintained.

It should not, moreover, be entertained for disorganization of the hip-joint the result of synovial disease, unless very obstinate and extensive and the general health of the patient is clearly yielding to the disease, nor should it ever be performed for acute suppurative disease.

On the other hand, it should always be entertained when it is clear that extensive bone mischief or partial necrosis exists, it being tolerably certain under such circumstances that a cure by natural processes is highly improbable; and when the general health of the patient is clearly being sapped by the local disease, whether that disease be in the bones or synovial membranes, or both.

The operation of excision is best performed by a slightly curved incision extending from two to three inches above the trochanter along its posterior border to two to three inches below, more room being obtained when required in exceptional cases at the upper angle of the wound by a cross incision. By this incision there is ample room for the rapid exposure and enucleation of the head and neck of the bone, and subsequently for free drainage. There seems also an equal unanimity amongst those who practise excision, that the head, neck, and trochanter (major) of the bone should be removed, the latter, when left, acting as a constant irritant against the soft parts and pelvic portions of the acetabulum, thereby retarding recovery. In the removal of the bone, the chain saw

is often of great use. When it can be effected, the shaft of
before the head is removed. The surgeon should preserve all
bone as much as possible, and, when the periosteum can be
Dr. Sayre, of New York, who has paid special attention to
operation as follows ('Brit. Med. Journ.,' July, 1871): "Wh
to another stage, where sinuses have occurred and discharged
down to dead bone, there is nothing to be done but to exsect it
above the trochanter major, midway between it and the crest
of the acetabulum, a semilunar incision, the belly of the curve
of the trochanter major, going straight down to the bone *thr*
then pull the soft tissues on one side, and taking a small but str
far round the bone on each side as you can reach, at right ang
so as to divide the periosteum completely. You then take a st
tor, with a large handle, and the end slightly curved, and go in
peel off the periosteum, and, as a matter of course, all the m
the joint thoroughly, and turning the head of the bone out, th
from the inner portion; you then saw off the bone above the
away the head and neck of the bone with the trochanter majo
you keep the leg pulled out to its proper length, by putting on
you can send the patient out into the air the next day." I ha
Dr. Sayre's own words, and am disposed to think as well of i
ment of hip disease. His wire breeches, however, I have nev

When the acetabulum is diseased, that is, necrosed, it may
my own cases, I removed large portions of the bone, and in
good result; indeed, there is reason to believe that, when the
case is not rendered more hopeless; for, as Holmes has well p
a strong fascia which separates the floor of the acetabulum fro
and prevents all contact with the viscera or their cellular conne

After the operation, the wound had better be left open to gr
tension should be applied to prevent the end of the bone from
my own double interrupted splint being the best for the purp
soon as the parts have fairly healed, passive movement may be
ble to what an extent useful movement is often secured, the
to walk upon the limb, but to flex, abduct, and adduct it, near
shortening being the only fault.

Amputation at the hip-joint may be entertained in hip diseas
by natural processes, however ably assisted by art, has been
powers of the patient admit of a reasonable hope of recovery.
sion has been performed and failed. It is often successful even

Excision of the hip-joint for gunshot or other traumatic aff
be recommended. The report of Dr. Otis, in the admirably
Department of Washington (No. 2), proves this to demonstr
cases only eight recovered; ninety per cent. having proved fa
shows, that, neither by the expectant treatment nor amputati
He concludes, that excision of the hip may be performed in u
shot fractures of the joint; that if unsuccessful, it relieves pai
risk than amputation, although life is probably prolonged for
pectant treatment. Professor Langenbeck, however, shows in
wounds of the hip-joint, as translated by J. West, of Birming
eight cases in which conservative treatment was employed,
out of thirty-one cases treated by resection, eighty-three per c

ON THE TREATMENT OF SUPPURATION OF THE

It may safely be asserted that in no cases of inflammatory
which disorganization has not taken place should the idea o
entertained; as, so long as this change is warded off, a reas
either a movable or stiff joint and consequently of a useful limb
may be seen in which this rule is inapplicable, but they are ra

When, however, suppuration has taken place, the questio
naturally suggests itself, and the surgeon considers whether n
tent to conduct the case to a successful issue; whether the loca

as to be incurable, unassisted by art, or the general powers of the patient are sufficient to bear up against the demands that of necessity will be made upon them in the progress of a natural cure; and last, but not least, if it is expedient to make the attempt.

These questions require for their solution much knowledge, thought, and judgment, a careful weighing of the probabilities of the case and of the cause of the disease. When the disease is in the synovial tissue alone and the powers of the patient are good, a cure by natural processes, assisted by art, is generally to be secured; for pathologically in such cases, there is no reason why recovery should not take place. Whereas, on the other hand, when the disease has originated in the bone, spread to the synovial membrane, and been followed by disorganization of the joint, a cure by natural processes is so improbable, that the removal of the diseased part by some operation is generally demanded, for pathologically, good reasons exist why recovery cannot take place, and clinically this observation is borne out.

It is true in suppuration of a joint from synovial disease, pulpy or otherwise, the result of a so-called rheumatism settling in the knee, or of a puerperal synovitis, a traumatic synovitis, a gonorrhœal synovitis, or any other, a cure with anchylosis is by no means uncommon, yet in all these, during their acute stage, the danger is always great, and it often become a question whether an amputation is not needed to save life, or to give the patient a chance. Amputations, however, undertaken for acute suppurative disease are mostly fatal, and operations of excision are likewise equally unsuccessful. Indeed, I hardly think either of these operations justifiable under such circumstances, and in this opinion most are agreed. What I believe to be a better practice is making a free excision into the joint—free enough to let out the pus that it contains, as well as to allow a free escape of all as it forms, and the introduction of a drainage tube, together with the daily washing out of the joint with iodine water. No retention of pus should be allowed under any circumstances.

When suppuration has been set up in a joint from the degeneration of the pulpy synovial disease, the benefit of a free incision is very great, and it should be practised with a good hope of success before any other operative measure is undertaken. When, however, suppuration in a joint has followed the extension of inflammatory mischief from the bones, the hope of securing a good result without operative interference is very slender; since, as a rule, dead bone exists in the joint to keep up irritation, and as long as it remains a recovery is very improbable. It is true, Nature does much in many cases towards this end, but she rarely is competent to effect the cure without surgical aid.

In the following cases these points are well seen:—

CASE.—DISEASE OF THE KNEE-JOINT—SUPPURATION—REMOVAL OF NECROSED BONE FROM THE JOINT—RECOVERY WITH ANCHYLOSIS.

James W—, æt. 17, came under my care in May, 1866, for disease in his right knee-joint of one year's duration, which had followed a fall upon the part. Swelling appeared directly after the accident, attended by severe constitutional disturbance and local pain. Suppuration also rapidly followed, and several large openings made their appearance eight weeks after the accident. When I saw him, the joint was enlarged from inflammatory thickening of the soft parts, and was clearly undergoing anchylosis. The sinuses were discharging, and a probe passed into one readily detected dead bone in the joint. In September the man was admitted into Guy's under my care, and on October 13th, through a moderate incision made on the inner side of the patella, two flat pieces of what were clearly the articular facets of the tibia, were removed. Rapid recovery and firm anchylosis of the joint followed.

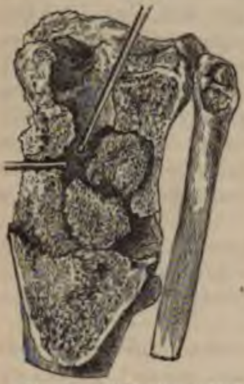
CASE.—DISEASE OF THE KNEE-JOINT AS A CONSEQUENCE OF ARTICULAR OSTITIS OF TIBIA—REMOVAL OF THE SEQUESTRUM FROM BONE—RECOVERY WITH AN ANCHYLOSED JOINT.

Henry R—, æt. 14, came under my care at Guy's Hospital on May 17th, 1867, for extensive disease of the shaft of the right humerus and head of the left tibia with sinuses which had existed for several years. The left knee had been enlarged from effusion for a year, but had never suppurated. When admitted, there was necrosis of the shaft of the humerus and likewise of the head of the tibia, while dead bone was readily felt with a probe in both parts. In the tibia the bone was clearly near the joint, which was enlarged from expanded bone and thickening of the soft parts around. There was no effusion into the joint, and hardly any movement in the articulation. In November, 1867, I removed a mass of diseased bone from the tibia, and fixed the leg upon a splint. In January, 1868, I removed a sequestrum from the arm, which included nearly the whole shaft of the humerus, and a good recovery ensued. In six months the patient left the hospital with a stiff knee and a sound arm.

CASE.—DISEASE OF THE KNEE-JOINT AS A RESULT OF ARTICULAR OSTITIS ENDING IN NECROSIS—AMPUTATION—RECOVERY.

Edward L—, æt. 14, came under my care at Guy's Hospital on September 8th, 1868, for disease in the left knee-joint of seven years' standing, which had been discharging for many years. On admission, the left knee-joint was completely disorganized and much enlarged; it was also partially anchylosed. Below the joint, a sinus existed leading into the head of the tibia, and through this sinus dead bone was felt. The boy's health was very bad, and it was clear that nothing but amputation could be entertained. His urine was albuminous. The operation was performed on September 17th, and a good recovery ensued. On examination of the joint which was disorganized the head of the tibia was found to be perforated with a channel which led from the joint to a mass of necrosed bone, and the articular facet of the tibia was likewise necrosed. The disease in the joint clearly had been secondary to the disease in the bone. The preparation is depicted in Fig. 562, and the drawing shows well the condition of the tibia.

FIG. 562.



Abscess of tibia, burrowing into knee-joint with necrosis.

REMARKS.—These three cases show well the results of articular ostitis when passing on to necrosis in the knee-joint, and fairly indicate the kind of practice that should be applied. In the first case, nature had done her utmost towards obtaining a cure, the knee of the patient having been on admission partially anchylosed; and, had it not been for the presence of the necrosed articular facets of the tibia, a complete natural recovery would have taken place. The surgeon's duty in this case was clearly to remove from the joint what seemed to be the sole obstacle to a natural recovery, the necrosed bone, and the complete success of the treatment justified the step, for the boy ultimately had an admirable limb. In the second case, the disease was of precisely the same character, and natural processes had, also, done their utmost towards the establishment of a cure, but the presence of necrosed bone in this case, as in the former, interfered with the recovery and prevented its realization. On the removal of the bone from outside the joint, natural processes went on without interruption towards the attainment of their end, and a complete recovery with anchylosis was obtained. In the last case, the same cause, articular ostitis, and the same result, disorganization of the joint, were clearly present; but the local disease in the bone was too extensive to allow of any hope of good being derived from its removal, while the general condition of the patient was too precarious to allow of the attempt. As a consequence, the only operative interference that seemed justifiable was carried out, and the issue of the case was all that could be desired. In disorganization of a knee-joint, therefore, the result of articular ostitis, of an abscess in the epiphysial extremity of the bone bursting into the joint, of disease in the epiphysial cartilage between the shaft and epiphysis, or, of a sequestrum in one or other of the bones entering into its formation, some operative measure is usually required; and, when the diagnosis of the case is tolerably clear, the practice ought to be decided, as delay cannot be of any use. The disease must be removed. What ought that practice, then, to be? Should it be excision or amputation? Let us refer to facts to help us towards a solution of these points. I have a table of 294 cases of *amputation of the thigh* for chronic disease of the knee-joint, at various ages, and Mr. Mac Cormac tabulates 137, the total making 431. Of these, 96 died and 335 recovered, the mortality being 22 per cent., or 1 in 5. On referring to Dr. Hodges's work, I find 178 cases of *excision of the knee* undertaken solely for chronic diseases of the knee, of which 70 died, and 108 recovered, the mortality of excision being 39 per cent., or 1 in 2½ cases. In this comparison, the circumstances are exactly similar; both operations being undertaken for chronic joint disease, and the mortality is exactly double. In my table of amputations, I have carefully guarded against any fallacy, and have included only my own statistics,[1] Mr. Callender's,[2] Mr. Mac Cormac's,[3] and Mr. Holmes's,[4] all of which are equally indisputable; and in the table of excisions I have gone to Dr. Hodges's work, who, to make this point certain, states, that with three exceptions performed for acute inflammation of the articulation, excision of the knee has probably never been undertaken for any other than chronic disease or white swelling. Mr. Swain, the author of the Jacksonian prize essay on "Excision," and a warm advocate of the operation, has given us statistics on this subject, and from his book (pp. 62 and 64) I have extracted the following facts: Up to 1865, there had been 316 cases of excision of the knee. Of this number 85 died, or 26.8 per cent.; 9 of these died after amputation which had been performed in 39 cases after excision. Since 1865, 74 cases are given, 25 of which died from the operation, or 33·7 per cent.; 4 also died out of 11 that underwent subsequent amputation; in all, 29 cases out of the 74 died, or 39 per cent. Mr. Swain gives us also a select list of cases numbering 82, of which 15 died from the effects of the operation, while 4 others recovered after amputation. We have thus 472 cases of excision of the knee and 129 deaths, or 27.3 per cent., 13 of these being after amputation; 41 other cases underwent amputation and recovered. Taking the whole number of 472 cases, 302, or 63.9 per cent., recovered after excision; 41, or 8.7 per cent., recovered after secondary amputation; 129, or 27.3 per cent., died after excision: the mortality from excision was thus greater than from amputation in the same class of cases, the relative proportion being 27 to 22 per cent. "It is also," adds Holmes, "a somewhat suspicious feature in Mr. Swain's table that all the 302 recoveries are claimed as being with useful limbs. If the information had been at all adequately full, there would surely have been a category of recoveries with the limb more or less useless;" since it is a well-known fact that the utility of the limb in many cases in which it seemed perfect at first becomes destroyed by subsequent changes. In childhood, suspension of growth is not an unfrequent result, and, when the whole epiphyses are removed, it is to be looked for. It is true that Mr. Swain gives somewhat different results from the same statistics, as he actually numbers amongst the recoveries after excision, all cases that subsequently underwent amputation, thus of course giving a far too favorable coloring to the operation he is *advocating*.

If, however, we look to *the results of both operations as performed at different periods of a life*, a point of comparison of immense importance, although entirely ignored by Mr. Swain and other advocates of excision, and I wish its advocates would consider well these points and not pass them by as of no importance, the following striking result comes out:—In my own table of amputations for chronic disease of the knee in patients under twenty years of age, out of 69 cases only 3 died, or 4.3 per cent., or 1 in 23 cases. In excision for the same class of cases performed at the same period of life, out of 97 cases 27 died, or 27.8 per cent., or 1 in $3\frac{2}{3}$, the different degrees of mortality of the two operations under twenty years of age being as 4.3 per cent. to 27.8 per cent. *Excision being nearly seven times as fatal as amputation during young life*, it may thus fairly be asked whether the advantages of excision are so great as to justify its performance in the majority of cases of disease of the knee at that age. In amputations undertaken between twenty-one and forty years of age for chronic joint disease, out of 119 cases 38 died, or 32 per cent., or 1 in 3; in excision, undertaken under similar circumstances, out of 74 cases 39 died, or 52.7 per cent., or more than 1 in every two cases, the difference between the mortality of the two operations, 32 per cent. and 52.7 per cent. respectively, being 20 per cent. against excision.

Summary.—It would thus appear that it is in young adult life that excisions, although always more fatal than amputation, are the most justifiable; that in childhood they are far too dangerous; while in patients past middle age, all admit their inapplicability. And yet it must be admitted that excision of the knee-joint is a good operation; and that by it, when successful, a far better limb is given than after amputation. The truth must be recognized, however, that the operation is, as hitherto practised, much more fatal than amputation; although it may with confidence be asserted that the cases in which amputation has been performed are, as a rule, far more severe than those in which excision has been practised; for the advocates of excision are disposed to operate at a somewhat earlier period of disease than the advocates of amputation; that is, the former often remove a disease they believe it is inexpedient to leave to be cured by natural processes; whilst the latter only remove a limb when all hope of a natural cure has passed away, and the operation is a necessity to save life. Are the advantages of excision, therefore, so great as to justify a surgeon in submitting a patient to an extra risk in order to secure them? As hitherto practised, and as a general rule in surgery, I have no doubt in answering in the negative. In exceptional cases, the risk, it is true, may be run; but excision, as a rule of practice, does not appear to be sound. Whether better results would not be secured by an earlier operation is an open question. Prof. Humphry's cases recently published, and my colleague's, Mr. Howse, rather tend to show they would; for, after excisions, undertaken with a patient in good health, or at least not worn out by suppurative mischief, a good result may fairly be expected. But is the risk of the operation, when performed under these favorable circumstances, so slight as to justify the surgeon in throwing aside the hope, and perhaps fair expectation, of securing a recovery by natural processes? Is excision of the knee to be an operation of expediency and not of necessity? We want facts to prove this fully; but, as far as present experience goes, it seems to show that, if the operation is to be a successful as well as a general one in surgery, it must be undertaken at a somewhat earlier period of disease than that at which the question of amputation has to be mooted; that it should be performed before surgical fever has reduced the powers of the patient, and complete disorganization of the joint has taken place. In fact, it should *not* be practised when an operation is demanded to save the life of a patient, for under such circumstances a better chance is given by amputation, but when the local disease is found to be steadily progressing in spite of treatment, and disorganization is threatening. As a substitute for amputation undertaken in extreme disease to save life, facts tell against the practice; as an operation of expediency to gain time, the few facts we possess tell in its favor. For my own part, I am disposed to think, that under these circumstances there seems to be some hope that excision may not only be a successful, but also a justifiable operation, and that it will not necessitate an increased risk to the life of the patient. In doubtful cases, amputation is the more desirable as it is the safer operation; and since the great object of our profession is to prolong and save life, other objects ought always to be subsidiary to this great aim. In acute suppuration of the knee, excision is never successful. Excision for gunshot wounds has been proved to be most unsatisfactory; indeed, as a practice in such cases, it seems hardly justifiable. In compound dislocation it has been successful. Canton and M. Spillman have published such cases, but upon the whole, the evidence we possess is not much in its favor in traumatic cases. Resection in cases of deformity as a consequence of disease is probably a better field for the operation; and Drs. Barton and Buck, of New York, have demonstrated its value.

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[1] 'Med.-Chir. Trans.,' vol. xlii.

[2] Ibid., vol. xlvii.

[3] 'Dub. Quart.,' August, 1868.

[4] 'St. George's Hosp. Rep.,' 1866.

The operation.—The best incision is that practised by Fergusson, and suggested by Park; a straight one across the joint below the patella from the *posterior* edge of one condyle to the corresponding part of the other. When the tissues over the knee are bad, the incision may be curved, forming a flap. The old H-shaped incision is now rarely practised. Humphry follows Mackenzie in making the semicircular incision with the convexity downwards, and Bickersteth, of Liverpool, makes a vertical incision on the inner side of the patella. The joint should be opened at once by dividing the ligamentum patellæ and the capsule of the joint, an assistant flexing the leg fully upon the thigh, thereby facilitating this part of the operation. The soft parts ought then to be turned back off the patella and that bone removed, there being no object in leaving it, but many reasons for its removal. The joint having been freely exposed by the division of the lateral and other ligaments, and by the forcible projection of the condyles, the lower two-thirds of the cartilaginous extremity of the femur is to be excised, care being taken not to injure the popliteal vessels which lie in close contact behind; the whole of the epiphysis should not be removed. This section should be made completely at right angles to the shaft of the bone. The articular surface of the tibia must then be dealt with in the same way, no more of the bone being removed than is necessary. To do this, the bow saw known as Butcher's is the best, the section being made from behind forwards. In both bones, when possible, it is well not to encroach upon the epiphysial cartilage. In dividing the bone, care is required not to strip off the periosteum above the line of section. When the surfaces are not healthy, or they do not come together in a straight line, another section may be made, it being a point of primary importance that a perfect adjustment of the bones should be secured. To aid this, the osseous suture, as first employed by Gurdon Buck, and practised by Nélaton and some English surgeons, is to be recommended. All bleeding ought to be arrested by ligature or torsion of the vessels or by cold affusions (a point much insisted on by Prof. Humphry) and the parts brought well together by sutures, some immovable apparatus being adjusted before the patient is taken from the operating table. The splint I prefer is the one figured below as used by my colleague, Mr. Howse. It is made of tinned iron, and the limb is fixed in it by a waxed bandage. Dr. P. Heron Watson employs with the plaster of Paris an anterior iron suspension rod. Salter's swing is an invaluable adjunct.

FIG. 563.

Splint for excision of knee.

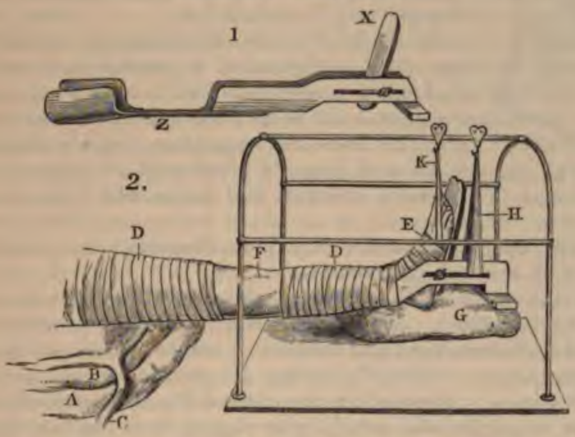


Fig. 1, Splint; Z, sliding bar; X, foot-piece. Fig. 2. Limb fixed in splint after operation; A, mattress; B, water-bed with pipe (C); D, waxed bandage; K, longitudinal band to support heel fixed by strapping (E); H, band to support splint; G, pillow.

Dr. Humphry first fixes the limb upon a posterior splint and foot-piece, then uniting the edges of the wound by sutures, he applies well padded long splints to the sides of the limb, the wound being left exposed. "I am very particular," he writes ('Med.-Chir. Trans.,' vol. lii), "to adjust things well and firmly in the first instance, and am very unwilling to disturb the limb afterwards. Indeed, I frequently do not remove any of the bandages or splints for five, six, or more weeks, and by this care and perfect quiet I endeavor to promote immediate union. This perfect quiet and abstinence from removal of the bandages first applied is, I consider, a very important item in the treatment. It is equally important not to discontinue the splints till the bones are quite firmly united, till the patient can raise the limb from the bed by its own muscles, without any movement being perceptible between the tibia and femur. It is necessary to make quite sure of this."

Dr. Humphry adds "that excision of the knee is not an operation of much danger;" but it must be remembered that he has little or no faith in the cure by natural processes. He believes such a cure in the bulk of cases to be hardly worth the attempt, and advises that excision should be employed early so as to bring about by operation that condition which we would gladly see attained without such interference.

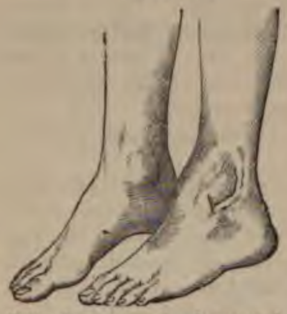
ON SUPPURATION OF THE ANKLE-JOINT.

When the *ankle-joint* has undergone disorganization and is suppurating, the benefit to be gained by a free incision into the joint is very great, a cure with a movable articulation being often obtained by these means. When this end is not secured, a recovery by anchylosis may be looked for, it being exceptional for any more active interference to be required, except when the bones are extensively involved.

When necrosis of one of the bones entering into the formation of the joint is present, recovery may be looked for on the removal of the diseased bone. In the case illustrated in Fig. 564 I removed the necrosed upper half of the astragalus with an admirable result, and a good foot with some amount of movement was secured.

Under these circumstances, excision of the joint has been practised and with success. I have performed this operation on three occasions, and in two with a good result; in the majority of cases of disorganized ankle-joint I have obtained good results by the expectant treatment and free incision. Excision may be expected to be successful when the disease

FIG. 564.



Foot after removal of necrosed astragalus from child, æt. 6.

is limited to the articular surfaces of the bones, and it is in such that the treatment by incisions and the expectant principle is so successful. When the disease is very extensive, it is still a question whether amputation is not probably a better practice. Stokes, however, has collected fifty-one cases of excision, thirty-eight of which were successful, and in the 'Dublin Quart.' for 1870, an excellent example by Dr. Murney may be referred to.

In cases of injury, of compound dislocation, and fracture into the joint, excision is probably a sound operation. Mr. H. Lee has recently adopted it in two cases, and Langenbeck has practised it freely with success. Hancock ('Lancet,' 1867) gives 19 successful examples of the operation, quoting Heyfelder and Jaeger's practice in its support. In such cases, however, it seems well to practise it as a secondary operation.

With respect to the operation itself, I may quote Hancock's as practised in 1851, and given by Barwell with recent improvements.

The foot is first laid on its inside and an incision made over the lower three inches of the posterior edge of the fibula. When it has reached the lower end of the malleolus, it forms an angle and runs downward and forward to within about half an inch of the base of the outer metatarsal bone. The angular flap is reflected forward, the fibula about two inches above the malleolus is thus sufficiently cleared of soft parts to allow cutting forceps to be placed over it, when the bone can then be nipped in two and carefully dissected out, leaving uncut the tendons of the peronei longus and brevis. The foot must then be turned over. A similar incision should be made on the inner side, the portion in the foot terminating over the projection of the inner cuneiform bone. The flap ought then to be turned back, and the sheaths of the flexor digitorum and posterior tibial tendons exposed, the knife being kept close to the bone, avoiding the artery and nerve. The internal lateral ligament should be severed carefully close to the bone; and the foot is now twisted outwards, when the astragalus and tibia will present at the inner wound. A narrow-bladed saw inserted between the tendons into the inner wound will project through the outer. The lower end of the tibia, and then the top of the astragalus, should be sawn off in a proper direction. The only vessel that may require tying is one of the lower branches of the peroneal artery. The wound can be closed with sutures, except that part opposite the breach of osseous matter; and the leg and foot placed in a splint with a foot-board and cold water applied. Mr. Hancock points out the superiority of total over partial excision of the joint. Mr. Hey, of Leeds, in 1766, was the first surgeon who resected the lower ends of the tibia and fibula for compound dislocation, and Moreau, in 1792, for disease. Hancock, however, was the first to resect the joint as a whole. This operation has grown in favor during the last few years, and in select cases is doubtless beneficial.

ON SUPPURATION OF THE SHOULDER-JOINT.

Suppuration of the shoulder-joint is as successfully treated by free incisions into and the removal of necrosed bone from the joint as the same affection of any other articulation, and only when this treatment has failed or is inapplicable are more severe measures required.

Excision of the shoulder-joint, or rather of the head of the humerus, is an excellent operation in gunshot wounds of the joint, in compound dislocation, or in cases of disease where a cure by natural processes has failed after judicious treatment, owing either to the extent of disease in the bone, or the general feebleness of the patient's powers. "The ultimate results of excision of this joint, whether for injury or disease, are very satisfactory," says Hodges, but they are not more so than the ultimate results of a cure by natural processes, even with anchylosis; for whatever may be the capabilities of an arm after excision, they are equalled after a natural cure. Under both circumstances, in the majority of cases almost every movement can be effected except any overhand one, since the arm cannot be raised above the shoulder. A man whose shoulder I excised fourteen years ago was a coachman in 1872 and could drive a pair of horses with ease. A man upon whom Mr. Key operated was subsequently able to carry on his occupation as a hammerman at a large engineer's; and another case operated upon by the same surgeon twenty-one years before, in June, 1869, could "shoe horses with any man," and, as a blacksmith, felt no want in his arm.

In gunshot injuries to the shoulder, excision is now a recognized operation, the experience acquired in the American war having decided the point. Dr. Otis (Circular 6) has recorded, that in 252 cases of primary excision, 23 per cent. died; and in 323 secondary, 38 per cent.; primary excisions being thus more successful than secondary.

In cases, also, of tumors involving the head of the bone other than cancerous, excision is an operation of value.

The operation.—The best incision is the vertical, from the acromion process through the thickness of the deltoid down to its insertion. Some make an anterior in front of the deltoid. Nélaton used the transverse and Ashton Key the deltoid flap. When the vertical incision is made down to the bone, its head should be successively rotated outwards and then inwards, the surgeon making a transverse cut across the tuberosities to divide the insertions of the scapular muscles. The capsule may then be divided, and the head of the bone turned out of the wound and resected through the tuberosities. The long tendon of the biceps needs no special attention, as in cases of disease it has probably long gone or become fixed to the groove, and after resection of the joint is of no value. When the glenoid cavity is diseased, that is, when dead bone is detected in it, it should be removed; but, in a general way, it requires no treatment. When the vertical incision is employed, it is expedient to make an opening posteriorly through the soft parts at a point corresponding to the upper end of the humerus for the purposes of drainage—this opening being kept patent by means of a drainage tube. Whatever vessels are divided should be twisted; and the posterior circumflex artery at times gives trouble. After the operation, the arm should be abducted and placed on a pillow, the edges of the wound carefully brought together, and water dressing or dry lint applied. As soon as repair has fairly taken place, the patient may get up, the arm being well supported in a sling. Three or four months, however, are usually required before a useful arm is secured.

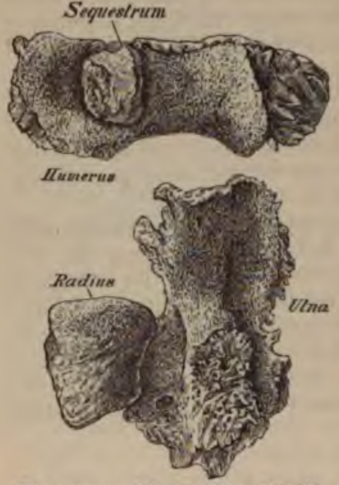
In this operation, M. Ollier makes much of preserving the periosteum, turning it back off the bone with all the soft parts by means of raspatories. This is not so difficult in cases of disease as might be fancied, a cut with a strong knife down to the bone should so divide all the soft tissues over the bone as to give admission to the edge of a raspatory for the purpose of turning them back. Ollier has done this on four occasions with success. In resecting the bone, no more need be removed than is necessary beyond the head and half the tuberosities; but, when the section is not healthy, another may be made. Four or five inches of bone have been removed in some cases, and yet a useful limb remain.

ON SUPPURATION OF THE ELBOW-JOINT.

There is a great difference amongst surgeons as to the treatment of a suppurating elbow-joint. In the Scotch school, excision is employed very freely, under the belief that a better arm more generally follows such a practice than results from a cure by natural processes, and that a joint with better movement is secured in a shorter time. I cannot say that I agree in this opinion, for in elbow-joint disease, where pus is let out by free incisions and good reparative power is present, recovery with a movable joint, and one admitting of pronation and supination of the hand is by no means uncommon. In other cases, anchylosis of the humero-ulnar joint may take place at a good angle, and pronation and supination of the hand retained; while in another class, anchylosis of both bones may take place with a very useful arm; and this result is secured by no greater expenditure of time than is required for repair after excision, and without the risks of an operation. In synovial disease ending in disorganization, this result is far from being uncommon; indeed, in such cases excision is rarely called for. In bone disease ending in necrosis, however, the same rules do not apply, for under such circumstances, no operation is of greater value than excision. (Fig. 565.)

In all cases of disease of the elbow-joint in which natural processes are incompetent to effect a cure, excision should be performed; amputation being had recourse to only when excision is inapplicable or has failed. In cases of compound dislocation, or fracture into the joint, excision is an excellent operation, and to gunshot wounds the same observations apply. Amputation of the arm for injured elbow ought to be performed in quite exceptional cases. Several inches of bone may be taken away in the operation. Mr. Tudor, of Dorchester, removed five inches, the patient subsequently having an arm capable of extensive motion in every direction, and with which he could lift a heavy chair ('Med.-Chir. Trans.,' 1858.)

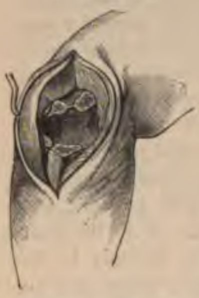
FIG. 565.



Parts removed by resection after disorganization of the elbow-joint as a result of necrosis of humerus.

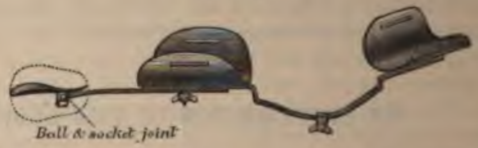
Operation.—The best incision is the vertical one over the olecranon process as practised by Langenbeck and the French surgeons, extending from three inches above to two below the joint, the incision dividing all the tissues down to the bones. The soft parts should then be carefully separated from the bones and drawn aside, the ulnar nerve being raised from the inner condyle, with the inner half of the triceps tendon and fascia. *No transverse incision across the triceps tendon should be made*, it being a very important thing, as recommended by Dr. R. Hodges, of America ('Hammond's Essays,' 1864), and recently well demonstrated by Maunder ('Brit. Med. Journal,' 1871), to retain the triceps tendon and fascia as it passes over the olecranon, with the fascia of the forearm and anconeus muscle; a thick body of muscle and fascia being in this way retained, extending from the arm above to the forearm below, which adds materially to the extending power and subsequent value of the limb (Fig. 566). The articular ends of the bones should then be turned out and removed. The surgeon need not be too sparing in his sections. In all cases the whole of the articular facets should be resected, and when the bone at the point of section is not quite healthy a second piece had better be removed. "If only the extreme ends of the bones be sawn off, anchylosis will most likely take place; while if the amount above prescribed, viz., the whole condyloid extremity of the humerus and all the sigmoid cavity of the ulna with the head of the radius, or even little more on both sides, be taken away, free motion may, under favorable circumstances, be expected" (Fig. 567). ('Holmes's System, vol. v.) I have at times regretted not having excised enough of bone, and particularly of the humerus; indeed, I strongly advise the surgeon in all cases to be free in his section of this bone, more particularly in excision for anchylosis. When possible, it is well to preserve the insertions of the biceps and brachialis anticus tendons by pressing them back from the bones. To preserve the periosteum in the operation as advocated by Ollier and Lagenbeck, does not appear from published facts or scientific reasonings to be a matter of importance.

FIG. 566.



Vertical incision for excision of the elbow-joint. From Maunder.

FIG. 567.



Splint for excision of the elbow, the splint allowing every movement.

After the operation, all hemorrhage having been arrested by torsion and the application of cold or very hot water, or, what is preferable, iodine water (℥ij ad Oj), this mixture checking capillary bleeding, the edges of the wound should be brought together at its ends, a drainage tube introduced, and the arm fixed at an obtuse angle upon such a screw splint as that made for me and figured above, the splint allowing every movement (Fig. 567), moderate pressure being applied and maintained for a few hours by means of a bandage. Absolute rest should be maintained till the wound has fairly healed and the powers of the patient been restored, when passive movement should be commenced with pronation and supination of the hand, the object of this operation being not only to remove the disease but to obtain a movable joint. When anchylosis follows, the operation in a measure is unsuccessful, for it has failed in one of its greatest advantages. In the most favorable cases, the amount of movement that is obtained is all that could be wished, indeed, it is little less than that of the healthy joint; in some cases, however, the joint is too loose like a flail, in others it is stiff, whilst in another class flexion and extension are good, but pronation and supination fail. In Mr. Syme's case of a man who had acted as a railway guard up to the time of his death, nine years after the operation, when the joint was dissected, the ulna and humerus were united by ligamentous union, and the end of the radius was polished off and played on the humerus and ulna upon a material much resembling cartilage. If the ulnar nerve be injured, much wasting of the muscles must occur; if divided, union of the ends may, however, take place. Syme has recorded such a case. When disease returns, a second resection may be performed, and even a third. When dead bone follows, it may be removed; indeed, nothing should be left untried before amputation is practised. I have performed the operation twenty-five times, and have never had to resect a second time, or to amputate; and in two-thirds of the cases good movement was obtained.

Partial resections of the elbow are to be condemned, as a rule, experience having indicated that they almost always end in anchylosis of the joint. In 1864, however, my colleague, Mr. Birkett, excised the olecranon for local disease following an injury, the man recovering after many months' treatment with a slightly movable articulation. I have also recently (1877) done the same—a barrow man, æt. 38, recovering with a joint fixed at a very obtuse angle, with limited movement. I have likewise removed from a disorganized elbow-joint of a woman, the necrosed olecranon process with a good result, the humerus and ulna subsequently anchylosing, the radius and hand retaining all their movement.

ON SUPPURATION OF THE WRIST AND CARPAL JOINTS.

In this affection, operative interference is rarely called for, beyond free incisions for the evacuation of pent-up pus, and removal of dead bone, recovery being aided by the absolute immobility of the hand and fingers, and such constitutional remedies as the wants of the individual case suggest. When, however, such means fail, or the local disease is too extensive or severe to allow of a natural recovery, excision of the joint should be performed, Lister, Hancock, and others have had successful examples. The best method of performing the operation is that of Langenbeck's, by means of a single free incision over the dorsum of the wrist extending along the centre of the metacarpal bone of the index finger. By this incision the lower part of the radial artery is avoided, and ample room given for the completion of the operation. Through the opening made the carpal bones can readily be turned out and the bases of the metacarpal bones with the extremities of the radius and ulna excised; the tendons of the wrist being held aside with ease. In performing this operation I have been struck with the facility with which it can be effected, and believe it to be preferable to the comparatively difficult and complicated method suggested by Lister, which is to be commenced by an incision made in front over the second metacarpal bone internal to the tendon of the extensor secundi internodii pollicis, and running along the back of the carpus, internal to the same tendon as high as to the base of the styloid process of the radius; the soft parts, including the extensor secundii internodii and the radial artery, being cautiously detached from the bone, external to this incision, and the tendons of the radial extensors of the wrist being also severed from their attachments, the external bones of the carpus will be exposed. When this has been done sufficiently, the next step is to sever the trapezium from the other bones with cutting pliers, in order to facilitate the removal of the latter, which should be done as freely as is found convenient. The operator now turns to the ulnar side of the incision and cleans the carpal and metacarpal bones as much as can be done easily. The ulnar incision is then made; it should be very free, extending from about two inches above the styloid process down to the middle of the fifth metacarpal bone, and lying near the anterior edge of the ulna. The dorsal line of this incision is then raised along with the tendon of the extensor carpi ulnaris, which should not be isolated from the skin, but cut as near its insertion as possible. Afterwards the common extensor tendons should be raised, and the whole of the posterior aspect of the carpus denuded until the two wounds communicate freely together, though the radius is not as yet cleaned. The next step is, to clean the anterior aspect of the ulna and carpus, in doing which the pisiform bone and hooked process of the unciform are severed from the rest of the carpus, the former with the knife, and the latter with the cutting pliers. In cleaning the anterior aspect of the carpus, care must be taken not to go so far forward as to endanger the deep palmar arch. The ligaments of the internal carpal bones being now sufficiently divided, they should be removed with blunt bone forceps; next, the end of the ulna is made to protrude from the incision and sawn off as low down as is consistent with its condition, but in any case above its radial articulation. The end of the radius can then be cleaned sufficiently to allow of its being protruded and removed. If this can be done without disturbing the tendons from their grooves, it is far better. If the level of the section is below the upper part of the cartilaginous facet for the ulna, the remainder of the cartilage must be cut away with the pliers. The operator next attends to the metacarpal bones, which are pushed out from one or the other incision and cut off with the pliers, so as to remove the whole of these cartilage-covered portions. The trapezium bone which was left in the early state of the operation, can now be carefully dissected out, so as to avoid any injury to the tendon of the flexor-carpi radialis or to the radial artery, and the articular surface of the first metacarpal bone then becomes exposed and removed. Lastly, the cartilaginous portion of the pisiform bone is taken away, but the non-articular part is left, unless diseased, in which case it should be entirely removed. This remark applies to the hooked process of the unciform. No tendons are divided in this operation except the extensors of the wrist. In order to insure motion of the fingers, passive movements should be performed from a very early period after the operation. For this purpose, Lister places the limb in a splint with the palm of the hand raised by a wedge of cork fixed below it, so that the joints of the fingers can be moved without taking the limb off the apparatus. When the splint is removed some flexible support is required for some time. (*Vide* Lister's paper, 'Lancet,' 1865.)

Excision of the joints of the thumb requires no description, and may be made by a vertical dorsal incision that interferes but little with the tendons of the part. The operation is very good, and should always be performed where possible for disease or injury. I have done it on many occasions with a good result, and at times recovery has been followed by movement. In the case of a man with neglected dislocation in which I performed it, hermetically sealing the wound with lint and the compound tincture of benzoin, rapid recovery followed with a movable joint. In a second case, in which I excised the phalangeal joint of the thumb, a like result ensued.

AMPUTATION IN JOINT DISEASE

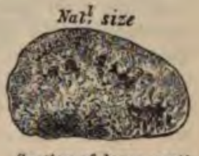
ought never to be resorted to until all hope of a cure by natural processes has been given up or failed; until incision into or the removal of necrosed bone from the joint has been deemed unsuitable, excision of the joint inexpedient or inapplicable, or the progressive nature of the disease and its sapping powers reveal the fact that if the disease be not removed the life of the patient is likely to be sacrificed. In amputating for joint disease, as for injuries, tumors, or other causes, the principles of "the least sacrifice of parts" should be followed, and no more of the body, under any circumstances, ought to be taken away than the necessities of the case demand. To carry out this principle the surgeon may, in pathological amputations, fearlessly divide tissues infiltrated with organized inflammatory products, and even cut through the walls of suppurating cavities or diseased joints, more particularly to save amputating above a joint. The value of this practice I have fully illustrated ('Lancet,' Jan. 23d, 1875).

Amputation for disease of the hip, shoulder, and elbow-joint is performed in only exceptional cases, and for the knee and ankle, it is yearly becoming less common. Yet it is a valuable operation in proper cases as well as the means of saving many lives. The mortality of amputation for chronic knee-joint diseases, at Guy's Hospital, is only one in seven and in young people under twenty years of age, one in twenty. In amputation for disease of the knee, where the end of the femur is sound and the articular facet alone diseased, the surgeon should sacrifice as little of the thigh as possible, the amputation should be almost at the joint, and the femur divided through its condyles, or just above, as in Stokes's amputation; a larger section of bone should only be made when the necessity of the case demands it. In disease of the ankle-joint, when excision and every smaller operation such as the removal of dead bone has been put aside, Pirogoff's operation should be employed in preference to amputation, if the calcis with the integument over it be sound; or Syme's amputation, unless the disease of the articular end of the tibia is too extensive. To amputate a sound foot for disease confined to the ankle-joint is a measure which can only be justified by peculiar circumstances, and as a general practice is to be condemned. Amputation of the arm for diseased elbow is still less justifiable, unless the local disease is too extensive to allow of excision, or the powers of the patient too feeble to admit of the attempt.

LOOSE CARTILAGES IN JOINTS.

Loose bodies ordinarily called loose cartilages are found in joints, and are most common in the knee, yet are met with in the elbow, ankle, and other joints. They are, doubtless, generally developed in the sub-synovial cellular tissues, and as they increase in size encroach upon the cavity of the joint by pushing the synovial membrane before them, and appear as warty or more or less pedunculated fringed growths hanging into the cavity. They may be single or multiple, and of all sizes up to that of a small walnut. When one of the masses becomes detached, a "loose cartilage" is said to be present. John Hunter taught, and Rokitansky believed, that they are formed by the organization of fibrinous coagula, but evidence is wanting to prove this view, for most, as pointed out by Rainey, contain ill-formed cartilage-cells and ossific matter and true bone-lacunæ are at times present (Fig. 568). Paget ('St. Barth. Hosp. Rep.,' 1870) has recently given good evidence of the truth of Teale's suggestion, that some of these bodies are really sequestra, and that "just as a blow on bone or tooth may induce necrosis and exfoliation without signs of destructive inflammation, so may it with articular cartilage; and the characteristics of these cases will be that after injury to a previously healthy joint, a loose body is found in it having the shape, and general aspect, and texture of a piece of articular cartilage with or without some portion of subjacent bone, and with its cartilage corpuscles arranged after the manner of the articular cartilage." Dr. Adams, of Dublin, connects their presence with osteo-arthritis.

FIG. 568.



Section of loose cartilage removed from knee. Prep. 1344^{40}, Guy's Mus.

A report upon these bodies, with microscopical drawings kindly etched for me by Dr. Goodhart, will help to the solution of some of these points:

"The term 'loose cartilage' is applied to two conditions which are totally distinct; the one where a portion of the normal articular cartilage has been detached by injury to the joint, and lies loose in its cavity; the other where bodies of more or less consistence, often cartilaginous or bony, are found, and which are new formations.

"Recent observations seem to show that the former of these two is by no means of infrequent occurrence, but it possesses no pathological interest whatever, and needs no description. A very good specimen of this form is to be found in the Guy's Hospital Museum, 1344^{62}. The latter, however, has frequently excited discussion among pathologists; so we will give in a few words what appears to be its usual composition, and our conclusions therefrom as to its mode of origin. Roughly speaking, loose cartilages are generally more or less smooth, of grayish color, and look, as their name suggests, like pieces of cartilage; but they may be nodulated and composed almost entirely of bony material (Fig. 568 and Prep. 956B, Hunterian Mus.). Even in that case, however, they have a thin film of fibrous material over them still, obscuring the bone, and rendering them cartilaginous looking on their external surface.

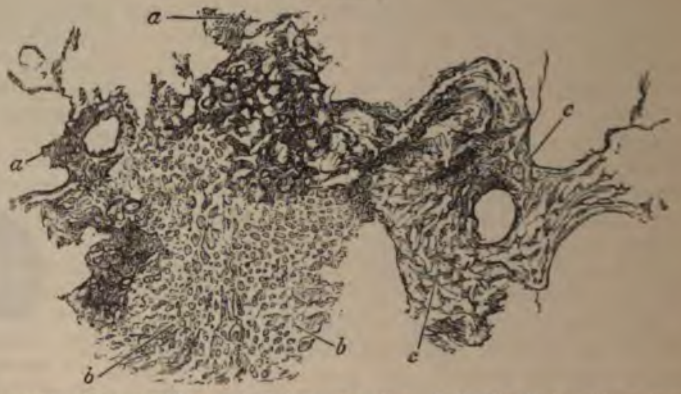
"The cases (five in all) that we have had an opportunity of examining have also shown more or less calcareous matter; they were never pure cartilage. One case in the Guy's Museum (1344^{20}), while appearing cartilaginous, cut with a creaking sensation, and under the microscope irregular deposits of calcareous matter and bone were found in all directions in its substance. In another (Hunterian Museum Cat., 957A) one surface is tuberculated and composed of hard nodules of ivory-like bone, while in a concavity thus formed is a cartilaginous mass. The bone on the surface in this specimen can only be compared to the nodulated excrescences found at the margins of the articular cartilages in cases of osteo-arthritis.

"The microscopical characteristics vary in each to a certain extent; some show fibro-cartilage, calcareous matter, and bone; others are entirely bony. The cartilage in the specimens which we have examined was very fibrous, and the cartilage-cells small. The calcareous matter had evidently not formed after any definite method, or in any purposive direction, as should occur in the building up of normal bone-tissue, and the bone had no regular system of Haversian canals or bone-corpuscles. The former occur as spaces of irregular shape and position, and the corpuscles, with but few canaliculi, are often more like calcified cartilage-corpuscles, and have no arrangement in relation to them.

"From this short description, and also from Fig. 568A, it will be seen that the specimens exhibit the formation of bone in its various stages; they show the primary cartilage stage, the secondary calcareous stage, and its ultimate issue in true bone, the bone being, as might be expected, of a somewhat irregular build.

"Having thus regard to their general structure, it would then seem most probable that since they are in their essence bony, loose cartilages must form in connection with bone-forming tissue, and these, so far as is known, are found in the involutions of the synovial membrane at the edges of the articular cartilages. This view is consistent also with the appearances found in certain joints in cases of osteo-arthritis; such, for instance, as a case recorded by Mr. Wagstaffe in the 'Pathological Society's Transactions,' vol. xxiv, 1873, p. 192; or specimens 954–956B in the Museum of the Royal College of Surgeons. In all these the formations may be seen *in sitû*. It is also in accord with the generally received opinion as to the more usual formation of loose cartilages at the present time.

FIG. 568A.



Microscopical appearance of loose cartilage. *a*. Calcareous matter. *b*. Small-celled cartilage, in parts more fibrous than represented.

"But in connection with this subject the so-called 'melon-seed bodies' found in joints and in the synovial sheaths of tendons and on bursæ must be considered. As is well known, they are generally abnormal developments of the synovial fringes, sometimes inflammatory, sometimes, perhaps, as was suggested by Rokitansky, due to cystic dilatation of the synovial folds, or perhaps to distension and coagulation within obstructed follicles. But whether originating in one or all of these various ways, being all in common due to changes in the synovial membrane and sub-synovial tissue, it is evident that they are loose cartilages in miniature, and only want size and the further change into cartilaginous matter to be true loose cartilages. But I have lately had an opportunity of making a very careful examination of some of these 'melon-seed bodies' from one of the sheaths of a tendon on the dorsum of the hand, which suggested the possibility, not to say probability of another mode of origin. I failed to find in any of them any evidence of organized tissue whatever. They contained no nuclei or cell-elements, and were entirely composed of a faintly fibrillated hyaline substance characteristic of coagulated mucus or fibrin. Hence it seems to be quite possible that loose cartilages may originate in a nucleus of fibrin precipitated in the course of a chronic inflammation, and that they subsequently grow by accretion, becoming calcareous by central petrifaction. On this point may be consulted a very interesting case of loose body in the peritoneum, recorded in the 'Path. Soc. Trans.' by Dr. Greenhow, vol. xxiii, p. 241. This specimen, in conjunction with 'melon-seed bodies,' makes one reconsider whether the opinion formed originally by John Hunter may not be correct, that loose bodies in the joints are sometimes formed from the 'living principle of the blood.'"[1]

Loose bodies, however formed, give rise to very similar symptoms, produced by the foreign body becoming fixed and pinched between the articular surfaces of the bones. The presence of one of them is usually discovered when the patient is walking or moving the joint, by some sudden inability to move the articulation and a severe and sickening pain, which is relieved only by the cartilage slipping from between the bones, which it usually does by a characteristic snap.

Some stiffness and slight inflammation of the joint may follow this injury, which by rest and treatment will subside in a few days, to be renewed upon a recurrence of the accident. In such a joint as the knee, the cartilage as often as not may be felt on manipulation, although readily slipping away under pressure.

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[1] For further information *vide* Virchow's 'Krankhaften Geschwülste,' vol. i; Marsh, 'St. Barth. Hosp. Reports.'

The TREATMENT may be described as palliative or operative. By the former, the cartilage is left untouched in the articulation; and by the latter it is removed or fixed in an unoffending position. In a general way the palliative treatment is the correct one to be enforced, for knowing how destructive inflammation of a joint following a wound too often proves, few surgeons would venture upon an operation without an absolute necessity, and such seldom exists, for by restraining the movements of the joint by some leather, felt, or other light casing, the foreign body may become fixed and consequently innocuous; indeed, by such treatment, Hilton has shown ('Guy's Reports,' 1868) that these cartilages may become absorbed. He fixes the loose body by means of a pad and strapping at the most convenient spot, and places the limb upon a splint. By this practice, pain is prevented, the peduncle of the cartilage cannot be stretched, nor the cartilage slip between the semi-flexed bones. In 1877, I thus treated a woman who had a loose cartilage the size of a large almond, and in three months, under observation, it gradually lessened until it disappeared. When inflammation of the joint follows one of the attacks of pain, it should be treated on ordinary principles. When, however, the cartilage, by its presence, produces such serious inconvenience as to destroy the value or use of the joint, whether from the frequency of the attacks, the amount of inflammation that follows, or the dread connected with the affection, some operative interference may be justifiable, and the cartilage should be removed either by direct or subcutaneous incision, the latter being preferable; but no operation should be undertaken till all inflammatory action has ceased, and the joint is in a quiescent state. With the view of removing the offending body by direct incision, a splint should be applied and worn for at least a week; the loose body should then by manipulation, or by such movement of the joint as the patient from experience knows will bring the cartilage under the surgeon's control, be brought up to one side of the joint, and in the knee, its usual seat is on one side of the patella, where it may be fixed with the finger. The surgeon may then draw the skin over it to one side, and cut down directly upon the cartilage, the incision being large enough to allow of its escape. The wound subsequently should be accurately closed by either a pad and strapping, or a pad soaked in compound tincture of benzoin, and the limb kept upon a splint till repair has been perfected.

The removal by subcutaneous incision consists in the fixing of the cartilage by means of a grooved or harpoon-shaped needle inserted into its substance through the skin; of, next, the introduction of a tenotomy knife beneath the skin down to the cartilage, and the division by a free sweep of the knife of all the subcutaneous tissues covering it in; then of the dislodgment of the cartilage by the application of strong digital pressure, or tilting it by means of the grooved needle into the cellular tissue of the parts around, and the application of a pad of lint over the spot where the cartilage escaped from the joint; finally absolute rest of the limb upon a splint must be subsequently enforced, and an ice-bag applied over the joint. After this operation, a small blister may be applied over the cartilage in the cellular tissue; Syme having found that by such means the foreign body becomes fixed in its new position and subsequently absorbed. To remove it by a subsequent operation is a recognized though rarely required measure. Mr. W. J. Square, of Plymouth, adopts the indirect operation, but instead of squeezing the cartilage completely through the subcutaneous wound, he is satisfied by simply pressing the foreign body into the subcutaneous opening and fixing it there by compress and strapping. At the Brit. Med. Assoc. for 1871, he related twenty-four successful cases. The subcutaneous operation is, doubtless, in either of its forms, the safer of the two described; the direct incision should be reserved for large growths or when the other has failed.

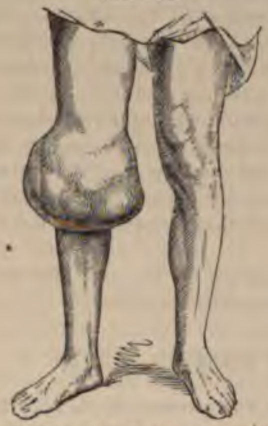
M. Larrey's statistics ('Gaz. des Hôpitaux,' No. 67) fairly prove the truth of these observations: Out of 129 cases operated upon by the direct method, 28 were fatal; and only 5 out of the 38 by the indirect. He concludes, after a careful analysis of cases, that the operation is a serious one when practised by direct incision, and a difficult one by the subcutaneous method, while extraction is more dangerous than the persistence of the affection. He believes the operation is indicated by the complete mobility of the foreign body within the joint; the persistence of the accidents caused by its presence, viz., pain, arthritis, and lameness; the failure of acupressure and other means for fixing the position of the foreign body; and the free consent of the patient after having been made aware of its dangers.

RHEUMATIC OR CHRONIC OSTEO-ARTHRITIS.

This is now a well-recognized affection, thanks to the labors of the late Dr. R. Adams, of Dublin, and his splendid monograph published in 1857; to Prof. Smith, of Dublin, and

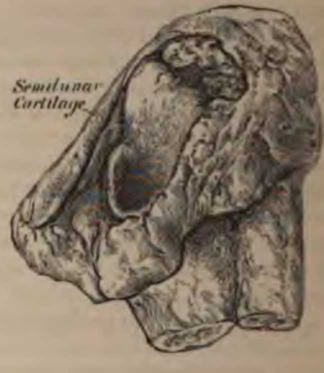
Canton, of London. It is chiefly seen in the middle-aged or old, though occasionally in young people. It may attack any joint, but is most common in the hip and shoulder, and generally comes on without any definite cause, yet I have known it, in not a few, follow directly upon some injury. A large number of cases put up as unreduced dislocations in the different museums are doubtless examples of this affection; the displacement of the head of the bones being the result of the disease. It is unfortunately called rheumatic, although it has no apparent connection with what is generally called rheumatism. It has probably acquired the name from its chief local symptom of aching pain in the joint, aggravated at night and in damp weather. The disease is at first associated with a dryness of the joint, but subsequently with excess of secretion even to a great extent; with some thickening and expansion of the head of the bones entering into its formation; some eburnation of the articular lamella of bone with disappearance of its inter-articular cartilage after it has undergone the fibrous degeneration; and, with what is still more peculiar, the deposition of new crests (osteophytes as they are called) or plates of bone around the margins of the articular facets and in the ligaments and synovial membrane. These crests often appear as ridges of bone which can be readily made out, and the plates may simulate a second patella when the knee is the joint involved. In the case from which Fig. 569 was taken, all these conditions were readily distinguishable; the bones and synovial capsule being enormously enlarged; the ligaments were so stretched as to allow of some lateral movements in the joint; and the characteristic rough, crackling sensation, which movement of the joint always gives, was most marked.

Fig. 569.



Osteo-arthritis of knee-joint. Drawing 33^{60}.

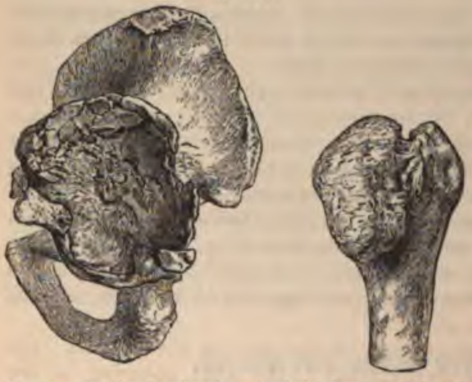
Fig. 570.



Wearing away of the head of the tibia in osteo-arthritis.

In still more extreme or neglected cases, the end of one indurated bone will grind away in time that of its contiguous bone, the condyle of the femur having in the case from which Fig. 570 was taken from ground down for at least an inch the head of the tibia. The preparation was made from the amputated limb of a man æt. 36, the leg having been taken off at the knee-joint, because the limb was a flail and the joint threatened to become disorganized; and an excellent stump was left.

Fig. 571.



Changes in the head and neck of the femur and in the acetabulum in osteo-arthritis.
Preparation 1131^{30}, Guy's Hosp. Mus.

When the hip-joint is diseased, the head of the bone flattens down, the neck shortens, the cup of the acetabulum becomes saucer-like, and around its margin as well as around that of the head of the femur, an irregular crust of bony outgrowths forms (Fig. 571); the cartilage likewise disappears, and the articular surface of the bones presents a dense eburnated appearance. In the knee-joint, one or both of the condyles of the femur becomes elongated and expanded, the head of the tibia flattened, the patella enlarged, and *osteophytes* of variable forms and dimensions fringe the margins of the bones. The synovial membrane also will be thickened, and at a late stage of the affection, expanded from effusion; the ligaments in this way becoming elongated and the joint dislocated. Adams's "additamentary bones" or new plates of bone of different sizes are found within the synovial membrane, with probably some pedunculated bodies upon its inner surface.

In its early stage, the disease is characterized by local pain, stiffness or rigidity of the joint, and local thickening and development of bony outgrowths, every movement of the joint giving rise to a characteristic crackling. In the later stage, the same pain manifests itself with thickening, bony outgrowths, effusion, greater mobility, and even dislocation, and finally disorganization.

I have a lady under observation in whom this disease is so developed in both knee-joints that the legs are as flails, the bones being enormously expanded and the joints distended, additamentary bones and osteophytes existing. She can only stand by means of artificial supports.

Treatment.—Little can be done by means of medicine to check the progress of this affection, beyond attention to the general condition of the patient. In the iodide of potassium we possess a drug that certainly relieves pain, and also, I believe, retards the progress of the disease, the liquid extract of bark or other tonic being a valuable adjunct. When pain is severe, anodynes may be given, such as Dover's powder, or the bromide of potassium in doses of gr. x or gr. xv, this drug going well with the iodide. Professor Smith, who has paid so much attention to this disease, thinks well of an electuary of guaiacum, sulphur, the bitartrate and carbonate of potash, ginger, and rhubarb. Dr. Adams prescribes the diluted phosphoric acid. Warm bathing is of use, as are also the mineral springs of Germany. This disease, although locally a painful one, does not appear to have a fatal tendency, and unless very neglected rarely goes on to the disorganization of the joint. To maintain rest is not a recommendation to be attended to, as it tends to make the joint stiffen in the early stage of the affection without arresting its progress. In the more advanced stage, when "hydrops articuli" is present, and the ligaments are so loose as to allow of the displacement of the joint, some mechanical appliance is called for, such as that afforded by simple strapping, or of some firm leather, felt, or other casing. In extreme cases, excision or amputation may be required.

ACUTE BURSITIS AND SUPPURATION AROUND JOINTS.

I have placed these two headings together, as there is good reason to believe that suppuration about the cellular tissue external to a joint is most frequently the consequence of an acute inflammation of some superficial bursa, and that it is only in exceptional instances such a connection cannot be traced. Over the knee- and elbow-joints, where this suppuration is generally met with, some blow, fall, or punctured wound may originate an acute inflammation in the bursæ of these parts, while the thick integument covering them prevents the inflammatory products making their escape externally, and favors their lateral extension: the abscess consequently in one case, after covering the knee, burrows backwards into the popliteal space, or in the other, comes forwards in the arm into its flexure; more commonly, however, it shows itself as a painful phlegmonous inflammation over and around the patella or olecranon process. In some examples, the suppuration is confined to the bursa, while in most, the inflammation will be found to radiate from these well-known points. In children, however, the connection between the suppuration and bursitis is not so readily made out, and there can be little doubt that at times it does not exist.

The severe cases of suppuration around a joint are most frequently met with in children of delicate and feeble frames, and in the badly fed, who are disposed to rapid extension of suppurative inflammation when started by any slight accident, blow, fall, or strain. When these large abscesses appear around the shoulder—a joint that is less liable to disease than any other—it has probably been caused by some strain or injury, when the child is dragged along by a careless or violent companion; or, it may be that the muscles of the parts are injured. At times, it is the epiphysial cartilage placed between the epiphysis and the shaft of the humerus which has suffered.

The diagnosis of these cases of suppuration external to the joint is not difficult. On examination it will be seen, that the swelling is external to the joint, covering in the well-known points of bone; in the knee, the soft parts probably will be raised from the patella, and fluctuation will be felt above and around it. There will be much local pain, but not so much constitutional disturbance as would exist with a suppurating joint; the joint, moreover, will be capable of some amount of movement without pain, a condition which would be impossible if the seat of the disease were in and not around it.

TREATMENT.—There is only one form of treatment on which reliance can be placed in these cases, and which consists in giving free exit to the pus. A free incision, consequently, should be made into the abscess over the seat of the bursa as soon as any pus can be detected. The limb should be raised, the joint preserved at rest by splints, and warm-water dressing or a poultice applied, and the joint should be kept absolutely quiet till repair has been completed. When the powers of the patient are feeble, tonics should be given. When the abscess is not opened early, it may open into the joint and produce an acute suppuration. I have known this happen in the knee with a fatal result. In the knee it is often necessary to make a free incision on either side of the joint as well as over the patella, in order to prevent burrowing.

CHAPTER XXXIII.

DISEASES OF THE BONES.

IN a pathological sense, diseases of the bone are identical with those of other tissues, while such differences as exist are due to their anatomical and physiological peculiarities; diseased action, under all circumstances, being materially modified by texture. In the bones, diseased action is thus modified by the presence of the inorganic material which they contain, two-thirds of their constituents being earthy, and one-third animal. This animal texture includes a fibrous periosteal membrane with cellular tissue beneath, as well as a finer endosteal membrane which lines the medullary canal. These two membranes are intimately connected together by delicate vascular and membranous links permeating the Haversian canals and canaliculi of the bone itself. The *exterior* of the bone is dense, and derives most of its nourishment from vessels ramifying in the periosteum. The *interior* of the bone is porous or cancellated, and derives its supply of blood from a distinct nutrient artery which runs in the endosteum, while the capillaries of both anastomose freely through the bone canals. The long bones also are built up of shafts (diaphyses) and epiphyses; the epiphyses being distinct from the shafts during the early years of life, and having their own vascular supply. The shafts and epiphyses are connected together by means of a layer of epiphysial cartilage, through which, as proved by Professor Humphry, the shafts mainly grow, though interstitial expansion has an influence in bone as in other parts. The epiphyses themselves are covered with articular cartilage that derives its nutritive supply from them. These anatomical points thus briefly sketched, are important to remember when the pathological are considered, as most of the peculiarities of bone disease are explicable by them. Thus, when a bone is inflamed, it can only be so through its soft tissues, its inorganic matter being affected secondarily. The periosteal and endosteal membranes being intimately connected, inflammation originating in one is very liable to extend to the other, and in proportion to the nature or amount of this extension will the inflammation be periosteal or endosteal, and the affection either periostitis or ostitis.

In long bones when disease attacks the shaft, it may become arrested by the epiphysis or epiphysial cartilage, the articular ends of the bones, and, consequently, the joints escaping. In periostitis, however, such a result is not always secured, for the synovial membrane of a joint, in a clinical point of view, may be regarded as a continuation of the periosteum, and pus beneath this membrane may burrow into the neighboring articulation, or, the inflammation may spread by continuity.

With these remarks, the diseases of bones may be considered, dividing them into the inflammatory affections; tumors of bone; atrophy, hypertrophy, rickets, and mollities ossium.

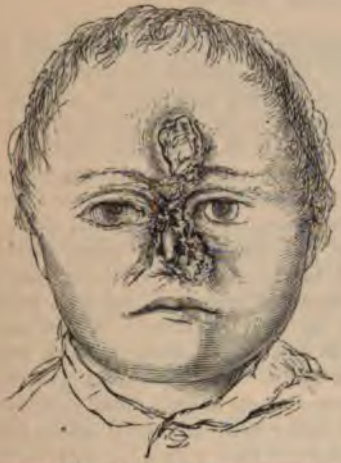
INFLAMMATION OF BONE

may be divided into the *acute* and *chronic*.

The *acute* may be idiopathic, or the result of some injury—division of a bone by operation or compound fracture—and ends in diffused suppuration and the more or less complete death of the bone. When originating in the periosteum and not wholly involving the endosteum, the outer surface of the bone may alone die; when originating in the endosteum and not wholly involving the periosteum, the inner portion of the bone may die and the shell escape; the whole bone dying when both membranes have been equally involved, whether commencing in one or the other. The extent and depth of the destruction of bone, or its "necrosis," is determined by the extent and intensity of the inflammatory action, and the degree in which the membranes covering and lining the bone have been involved.

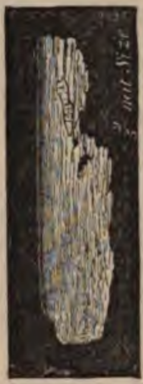
Thus, on the one hand, Fig. 572, represents the superficial necrosis of the frontal bone of a child, after its exposure from a lacerated wound caused by the gnawing of a ferret, and Fig. 573, a large shell of bone which exfoliated from the tibia after an acute periostitis. Fig. 574 represents a sequestrum, the result of an endostitis, osteomyelitis or ostitis (for all these terms are synonymous) surrounded by a shell of bone newly formed by the periosteum; while Fig. 575 illustrates the appearance of the limb so affected, taken from life, with the sinuses open leading from the surface of the limb through the soft parts of the shell of new bone to the sequestrum.

FIG. 572.



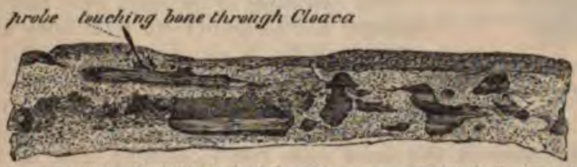
Superficial necrosis of frontal bone following wound caused by the gnawing of a ferret. Delsey W., æt. 7 months. June, 1874.

FIG. 573.



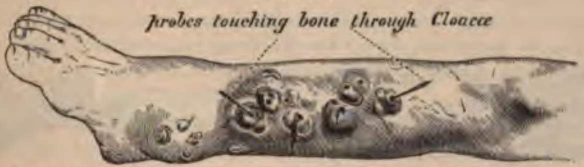
Shell of bone exfoliated as a result of acute periostitis. (Periosteal necrosis.)

FIG. 574.



Sequestrum composed of the shaft of the tibia surrounded by shell of new bone.

FIG. 575.

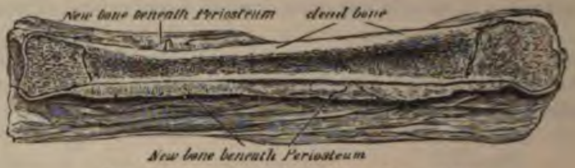


External appearance of limb, the seat of necrosis of the shaft of the tibia with cloacæ leading down to dead bone.

Fig. 576 represents a bone which died, nearly as a whole, from inflammation of both membranes, and upon the upper surface of which no new bone formed, the periosteum having been completely destroyed; although at the lower part, where the membrane was sound, bone has been renewed.

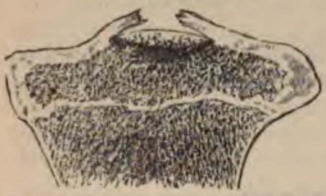
Death of the bone or necrosis, is not, however, the inevitable result of all inflammation, not even of an acute suppurative inflammation. In chronic cases, other changes occur, which are well seen in the articular extremities of the long bones, or spongy bones. They may be described as follows, quoting my own words, written in 1859 (on diseases of joints): In the earliest condition, simple vascularity will be the principal morbid appearance, the cancelli containing more serum than natural; but as the disease advances, the bone becomes larger than natural, this enlargement, in some cases, being very great. Upon making a section of the bone, the saw will break through its structure more easily than in a healthy specimen, its earthy constituents having diminished; and on comparing the structure of the diseased with a healthy bone it will be observed that its cancelli are much enlarged, and the columns radiate from the shaft in a palm-like fashion, as if they had been spread out from downward pressure. When the inflammatory process is of a tolerably healthy character, parts of the bone will appear denser and more indurated than the remainder, from the organization of the inflammatory deposit, this deposit in bone always becoming osseous; frequently, however, the death of the bone, with a small or large sequestrum, or a local or diffused abscess, is the result. If the denser portion of bone forming the shell is examined, it will be found thinner than natural, and appear as if it had been dilated, in some cases crackling on firm pressure. Where the articular extremity joins the shaft some new bone may be detected, thrown out as it were, to support its dilated body. The articulating surfaces of the bones will in some parts appear more vascular than normal; whilst in other more advanced cases, portions having been thrown off like a slough, will be found loose and lying in the joint, the denser portions of bone, as a result of articular ostitis, dying more rapidly than the cancellated.

FIG. 576.



Necrosis of the shaft of the tibia. Prep. 1243^{80}.

FIG. 577.

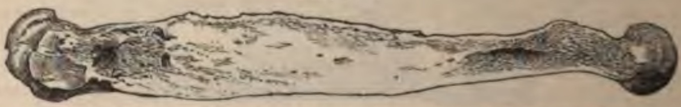


Necrosis of the articular lamella of bone with degeneration of cartilage covering it in.

The cartilages at the same time undergo degenerative changes and separate from their bony attachments more or less rapidly, in some cases being cast off as a slough, or shed as a nail or cuticle. Under these circumstances joint disease occurs. (*Vide* Fig. 577.)

In the shafts of bones, changes similar to these are equally manifest, the bone in the early stage first expanding, and, in subjects of better power subsequently thickening from the organization of the inflammatory exudation, the bones thus becoming solid and dense, and the subject of a condition known as sclerosis (Fig. 578).

FIG. 578.



Sclerosis of bone, the result of inflammation. From Prep. Guy's Mus.

In cases of inflammation of bone when the periosteum is not morbidly involved, a layer of new tissue secreted from the periosteum is poured out upon the bone, which at first is soft and fibrinous, and subsequently hard and osseous, this new material being reparative in its nature, and that from which the new bone will be formed. It may be only a few lines in thickness, though at times it is even half an inch (Fig. 580); and before it becomes osseous, it can readily be peeled off the bone by means of the handle of a scalpel or a periosteal elevator. It is to this tissue M. Ollier alludes, when he recommends the sub-periosteal resection of the shaft or articular ends of bone, for it is upon such mainly that the regeneration of a bone or part of a bone depends. Changes analogous to those described as going on in the periosteum, occur in the endosteum or medullary membrane of the bones, although not so well seen. The products, therefore, of a periostitis or endostitis vary with the character and intensity of the inflammatory process, precisely in the same way and under the same conditions as the products of inflammation vary in the softer tissues. In very intense inflammation and subjects of low power, the death of the inflamed parts is the result, of the periosteum with the bone depending upon it for its nourishment, of the endosteum with its bony fabric, or of the whole bone when both membranes are equally involved. When suppuration takes place, it may occur as a diffused abscess in and around the bone; when in the bone, it is known as osteo-myelitis or endostitis, and may give rise to a local abscess in the bone with or without necrosis or a sequestrum; and when around it as periosteal abscess, a condition which is mostly followed by a more or less extensive necrosis.

In local periostitis, a small portion of bone alone may die, and, as Sir James Paget has shown ('Clin. Soc. Trans.,' 1870), remain quiescent under a puffy or suppurating swelling.

The character of the discharge in these cases is of importance, and while pus the result of periostitis differs in no respect from that found in other tissues, in endostitis, ostitis, and osteo-myelitis, it is mixed freely with oil-globules. In a striking case of this latter affection in a girl, æt. 10, where a free incision was made down to the tibia, the surface of the fluid evacuated was covered with oil-cells. Roser has made a like observation.

ACUTE INFLAMMATION OF BONE,

whether periosteal or endosteal, osteo-myelitis, is a very grave affection, and is chiefly found during the growing period of bone before puberty. It occurs, too, in the feeble and cachectic, and in those termed scrofulous; in the shafts of the long bones, and such as are most exposed, as the tibia and ulna; although it is almost as frequently seen in the femur. The bones of the upper are probably more rarely affected than those of the lower extremity. It is often the result of some local injury or exposure, though as often as not no such exciting cause can be made out.

The disease generally is ushered in with a deep aching pain in the bone with local tenderness, intense constitutional disturbance, increase of temperature, and often a rigor. The pain in the limb is speedily followed by swelling which is evidently deeply placed, and is not marked by any external evidence of inflammation, such as redness; but as the swelling increases, the soft parts covering it become tense and œdematous, and the veins of the part look full, such symptoms indicating deep-seated obstruction, while any attempt at movement or pressure causes suffering. When the disease is situated in the articular end of a bone, it is constantly mistaken for rheumatic fever.

If the disease is *periosteal* in its origin, the skin soon becomes involved and local redness appears, the slightest touch exciting pain. If *endosteal* at the onset, gentle manipulation will be allowed, and many days will pass before redness and other external signs of inflammation show themselves, these appearing only when the disease has spread to the periosteum, and through it to the soft parts around. When suppuration ensues, the skin from being tense and œdematous becomes inflamed, and the constitutional disturbance worse; sleeplessness, and probably delirium with a feeble pulse appear; rigors become more frequent, pain is more intense, and unless relief be afforded by a free incision down to the bone, death by exhaustion and probably by blood-poisoning is apt to occur; since there is a close connection between acute inflammation of bone and septicæmia. (*Vide* Chapter I.)

When the inflammation is essentially *periosteal*, more or less well formed pus mixed with blood will be effused; though in feeble subjects it may be only a blood-stained serum containing lymph. In some of the worst cases of this disease, I have seen this effusion very copious. When, as a consequence of this affection, necrosis ensues and is periosteal in its origin, the outside shell of bone may alone die (Fig. 573); but when endosteal the periosteum may escape, though the greater part, if not the whole shaft of the bone may become necrosed (Fig. 574).

Endostitis being particularly prone to be accompanied by blood-poisoning, is, therefore, a far more serious disease than periostitis, whether as a primary affection or consequent upon the latter.

Acute ostitis, periostitis, or endostitis may attack the cranial, carpal, and tarsal bones, the shafts, articular ends of bones or epiphyses; and according to its seat or extent, it may terminate in recovery or in the complete death of either the centre or shell of bone. The best instance of death of the bone from periosteal inflammation is seen in the ungual phalanx of the finger, the bone dying as a whole some five or six weeks after the first onset of the inflammation, without any attempt at its re-formation. Such cases are generally, but wrongly, looked upon as *whitlows*. Of the tarsal bones, it is most common in the os calcis, large sequestra being often met with in this bone; periosteal necrosis is, however, comparatively rare in the calcis, except as a result of injury to its tuberosity.

When this disease attacks the articular ends of the bones, acute joint mischief is the general result, and when it follows the division of bone either by amputation, re-section, or after compound fracture, gunshot, or otherwise, it is a common cause of death, and too frequently is the precursor of septicæmia. Sir Joseph Fayrer, who has drawn attention to this fact, in his 'Annals of Med. Sciences,' 1865, looks upon the prominent fungous mass of granulations that is often seen covering the end of an amputated bone as indicative of the affection, and believes that the facility with which the surgeon passes a probe well into the medullary cavity through these granulations, establishes the diagnosis. He gives the general symptoms as pain in the part, œdema and swelling extending down the limb, general fever, with quick pulse and increased temperature, and more especially the recession of the soft parts, including the periosteum, from the bone, which is then left denuded at the bottom of the wound.

Jules Roux, of Toulon, first drew attention to this affection, and gave it the name osteomyelite. It is, however, essentially an endostitis, only of traumatic origin.

TREATMENT.—In all cases of acute inflammation of bone or periosteum, in which of necessity there must be effusion beneath the dense fibrous periosteal layer, there is no treatment equal to that of a free incision down to the bone; and if the disease is not arrested or modified by this practice, immense relief to pain is rapidly afforded. There is good reason to believe, too, that by such treatment the disease is often limited and even arrested as well as the death of the bone averted; for bone, like other tissue, is very prone to die when subjected to the compressing influence of a confined effusion.

When the upper part of the shaft, or the articular end of a bone is the seat of disease, this practice is very important. Before making an incision, there is no need for the surgeon to wait for the formation of pus, as to do this is generally to wait too long, for the object of the incision being to relieve tension, it should be carried out as soon as tension clearly exists. In a case of acute disease of the tibia with severe local pain and constitutional disturbance, I opened the periosteum on the fourth day before any external evidences of inflammation showed themselves, except turgid veins and bone enlargement. The incision gave vent only to blood-stained serum, but it was followed by immediate relief to all local and constitutional disturbance, and a rapid recovery took place. In this case, all evidence pointed to endosteal rather than periosteal inflammation, and yet the bone was saved. If the incision does not save the bone, it relieves symptoms, and what is more, it may limit the disease by preventing the pus from burrowing beneath the periosteum covering the shaft of the bone, into the neighboring joint. This liability to joint complication is, indeed, one of the strongest arguments in favor of the practice. The limb at the same time should be elevated, and hot fomentations applied; pain should be relieved by opium, morphia, chloral, or any other sedative, and the general powers kept up by abundance of nutritious food, such as milk; while stimulants should be cautiously administered. Billroth believes that one of the most efficient remedies is painting the affected limb with strong tincture of iodine till vesications form, fresh iodine being applied as the vesicles dry up.

When the inflammation ends in necrosis, it requires to be treated according to the mode to be referred to in a later page.

Occasionally as an effect of acute inflammation of the periosteum, much blood is effused between the membrane and the bone. I believe this result to be mechanical and due to the rapid separation of the periosteum, and it is always met with in acute cases.

ABSCESS IN BONE.

Abscess in bone is the result of a local inflammation, and may or may not be associated with the death of a small piece of bone. In some cases it is acute, but more generally chronic. To Sir B. Brodie's paper published in 1846, the profession is indebted for the best account of the chronic affection.

Bone is liable to an *acute* as well as *chronic* abscess. In the *acute* some necrosis is generally associated with it; but in the *chronic*, such an association is rare.

Not long ago, I treated a boy, æt. 17, who, after intense pain in the head of his tibia for three days, had local swelling and severe constitutional disturbance, that had been regarded as due to rheumatism. At the end of a month when I saw him, I made a free incision down to the bone to relieve pain, and give vent to any pus that might have found its way externally. A week later pus appeared evidently from the bone, for a probe could be passed through the wound into a cavity. Two weeks later or six weeks from the commencement of the symptoms, I enlarged my opening, and through the aperture in the head of the bone from which the pus had flowed, I removed three pieces of bone, together making one the size of a nut, which rested in a cavity lined with velvety granulations such as are so characteristic of an abscess. A complete recovery ensued. In another boy, æt. 16, in which severe local and constitutional symptoms had arisen early, I removed a similar piece of bone from a like cavity in the end of the radius, and with a similar good result. In both cases, acute inflammation of bone had ended in the formation of a local abscess with circumscribed necrosis, and recovery rapidly followed the surgical treatment.

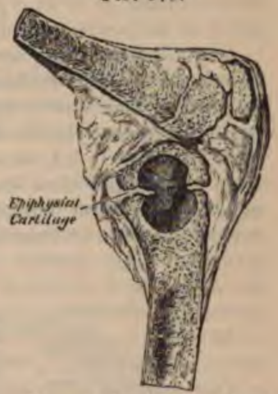
A few years ago, a child was brought to me, who had received when asleep an injury to the tibia, from a playfellow having attempted to drive a pin into the bone. Nothing beyond some slight local pain had followed the injury for a few days, when severe pain and swelling appeared, with fever, &c. I cut down upon the part with a view of giving relief, when the point of my knife went with a crackle through a thin layer of bone into a cavity, which gave vent to a teaspoonful or more of pus. Immediate relief followed the operation and a good recovery took place.

These three cases suffice to illustrate the fact that acute abscess in bone is met with, and to show its symptoms and treatment.

Chronic Abscess.

In 1773 William Broomfield, surgeon to St. George's Hospital, in his 'Chirurgical Observations,' writes:—"Whenever a patient complains of a dull, heavy pain, deeply situated in the bone, possibly consequent to a violent blow received in the part some time before, and though at the time the patient complains of this uneasiness within the bone the integuments shall appear perfectly sound, and the bone itself not in the least injured, *we have great reason to suspect an abscessus in the medulla.*" In 1824, Sir B. Brodie amputated a limb for incurable pain in the tibia, and in this case which Sir W. Fergusson has described "as one of the beacon lights of surgery never to be forgotten," "the lower end of the tibia is enlarged, and the surface presents marks of great vascularity; the bone in the preparation is divided longitudinally, and just above the articulating surface there is a cavity as large as a small chestnut. This cavity was filled with dark-colored pus. The inner surface of it is smooth. The bone immediately surrounding it is harder than natural."

Fig. 579.



Abscess in head of tibia; disorganization and dislocation of the joint. Prep. Guy's Hosp. Mus., 1245^{80}.

In these two extracts, written at an interval of fifty years, are embodied the clinical and pathological facts connected with this subject which are now recognized by surgeons.

This chronic abscess is generally met with in the articular ends of bones, that is, in their cancellous tissue, more particularly in the two ends of the tibia. I have, however, seen it in the condyle of the femur and the humerus, and in the shafts of the ulna, radius, and tibia. It may also occur in any bone. In Fig. 579 the cavity of such an abscess is illustrated, and in Fig. 562 is seen its opening into the joint. The history of these cases is generally obscure, an injury at times being its assigned cause. The most characteristic symptoms are a fixed, aching pain in the part, "the pain being a dull one, rather tending to produce sickness than to rouse" (John Hunter), exacerbations occur in its progress, when the pain becomes acute, fixed, and of a burning pulsative kind, "like the falling of drops of molten lead," as a patient once described it to me; there will likewise be local circumscribed tenderness or pain on firm pressure, with probably some evident enlargement of bone, and the sense of local heat.

In more advanced cases, the soft parts over the bone will be œdematous, and on firm pressure over the painful spot, a sensation of yielding will be given to the finger. In still more neglected cases, the abscess may make its way into a joint: while under fortunate circumstances it may advance forward and discharge itself externally.

Treatment.—"Abscess in bone may find its way to the surface," but "the crown of the trephine is often necessary in order to get at the seat of abscess," said John Hunter, in 1787 (MS. lec.). At the present day a like treatment is to be advised, as nothing less than the opening of the abscess in the bone is of any use, and this is usually done by means of a small trephine. The point to be selected for the operation is the painful spot, which should be marked before the patient is anæstheticized; the soft parts should then be divided by a crucial incision and turned back and the bone itself freely perforated, with the periosteum covering it. When the instrument has opened the abscess, pus will well up at once; the ring of bone raised by the elevator ought then to be taken away; the cavity, which is generally lined with smooth velvety granulations, is rarely very large, and the quantity of pus seldom above a drachm, although sometimes there may be more. After the operation the parts have only to be left alone to heal, recovery being very general.

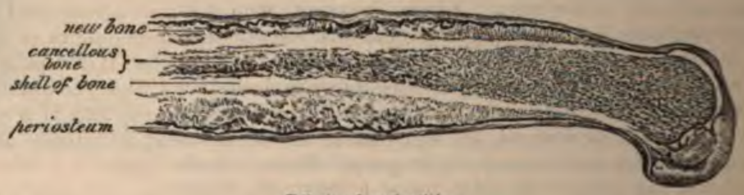
It is not always necessary, however, to trephine a bone, as a less severe operation is at times all that is required, and that is, its simple puncture by means of a drill; when the seat of the abscess is not very accurately defined the drill is probably the better instrument to use. In a striking caśe, I had in the spring of 1870, I carried out this operation and punctured the head of the tibia of a man who had all the external evidence of local ostitis and suppuration, such as pain, bone expansion, &c. I cut down upon the painful expanded part, and made two punctures with a drill, one of which clearly went into a cavity in the bone, as evidenced by the sudden loss of resistance. No pus, however, was seen to well up in the wound at the time, though soon after the operation, a free discharge took place. The operation was followed by complete relief from all pain, and in a month, the man left Guy's quite restored, and three months later he remained so. More recently, I arrested disease in the femur of a boy, æt. 18, by trephining the trochanter major and puncturing the bone with a drill through the opening.

This operation of drilling the bone seems to be good either for supposed suppuration or chronic ostitis. It is less formidable than trephining, and may be done in cases where the latter is inapplicable or not to be entertained; indeed, the two means may be employed together when the trephine has failed to open the abscess. Holmes's suggestion is good, viz., to pierce the walls of the trephine-hole in several directions with a sharp-pointed instrument, in order to remove the bone freely with a chisel, if a drop of pus follow any of these punctures.

Chronic Periostitis and Endostitis.

Chronic *periostitis* and *ostitis* are very common affections, more particularly involving the shafts of the long bones. The ostitis is probably the more common of the two, pure periostitis, unless from syphilis or injury being comparatively rare. These affections may be modified by syphilis, scrofula, or rheumatism, and may originate from some local cause or injury, but in all, their course is the same; the disease varying only in the rapidity of its progress, extent of its influence, and results. In one case, complete recovery may take place, the effusion being re-absorbed; in another, the effusion may become organized as a superficial node or bony outgrowth (Fig. 580), or as an enlarged, elongated area of dense bone (578). In exceptional cases, local suppuration may occur, giving rise to a chronic periosteal or endosteal abscess; in a large proportion of instances the bone dies wholly or in part, and thus gives rise to *necrosis;* whilst in some few, the bone, either upon its surface or interior undergoes a chronic disintegrating process known as *caries.*

Fig. 580.



Effects of periostitis.

The symptoms of chronic periostitis and ostitis (endostitis) are in their nature very similar to, though less severe than those of the acute, the most constant being a dull aching pain in the part of a persistent kind, aggravated at intervals, and on hanging down the limb; the pain being almost always worse at night, more particularly in syphilitic affections. The constitutional symptoms vary according to the severity of the local condition, febrile disturbance, and intensity of local action running hand in hand.

In *periostitis*, the pain is generally local and attended with swelling at an early period of the affection, indeed, within a few days of its onset. In *endostitis*, the pain is generally more diffused through the whole bone, and will continue for weeks or months without any external evidence of enlargement, being too often regarded as "rheumatic" or "growing pains." In *periostitis*, tenderness on manipulation is an early and constant symptom. In *endostitis*, the bone may be manipulated with gentleness without exciting pain; firm pressure, however, almost always causes suffering. In *periostitis*, the enlargement generally shows itself as a bossy or undulatory swelling on the surface of the bone, with one, two, or more nodes, upon the bone; syphilitic periostitis is generally multiple and undulatory, traumatic and other forms of nodes usually single. In *endostitis*, the enlargement appears as a general expansion of the bone in all directions; in rare cases as a distinct *elongation*. In *periostitis*, when suppuration is about to take place, external evidence will appear in the form of increased swelling and tenderness, while redness of the skin, œdema of the tissues covering in the node, and fluctuation will be present. In *endostitis*, terminating in abscess, there will be a great aggravation of local pain with constitutional disturbance, and often rigors; and, when œdema of the soft parts over the bone and external evidence of inflammation appear, the abscess is making its way externally through the periosteum (*vide* Abscess in Bone).

When *periostitis* causes necrosis, it is only of the shell of bone beneath the inflamed node (peripheral necrosis); the dead bone under these circumstances is exposed, and if covered it is by soft parts alone, and not by new bone (Fig. 569). When *endostitis* causes necrosis, it is usually of a greater or less mass occupying the centre of the bone (central necrosis), although sometimes the whole shaft or articular extremity of the bone dies. The dead bone or sequestrum is always more or less completely surrounded by new bone —a new periosteal formation (Fig. 574). When this new casing is incomplete, it is a fair proof that the periosteum has been involved (Fig. 576).

In necrosis of a long bone the result of periostitis and endostitis by extension, the hope of a new bone being formed is forlorn, as the periosteum—the chief bone-forming membrane—has been destroyed; while in the necrosis of endostitis, there is every hope of a complete restoration of the bone through its periosteal covering taking place, on the removal of the dead portion or sequestrum.

In the *necrosis of the skull* which is always periosteal, no new bone is formed, as the periosteum is destroyed. When following an injury to the skull it is preceded by "the puffy tumor of Pott." In syphilis it follows a suppurating node.

In a rare, if not unique preparation (Guy's Museum) of necrosis after amputation, taken from a patient of my own, the end of the divided femur died, and, at a later period, the periosteal sheath of new bone that formed around it also died, one sequestrum being found within the other on their withdrawal from the stump.

TREATMENT.—In *chronic periostitis* when suppuration does not take place, fomentations, with the elevation of the limb, sedatives to allay pain, and the internal use of the iodide or bromide of potassium, with or without tonics, according to the special requirements of the patient, are the most efficient means. In still more chronic cases, the use of a blister, or the repeated application of the compound tincture of iodine, is of value. If rheumatism seem to influence the morbid action, colchicum has a beneficial tendency. When nocturnal pain is great, besides the internal administration of opium or other sedatives, the external application of belladonna certainly gives relief. When pain is severe and unrelieved by such treatment, a subcutaneous section of the periosteum with a tenotomy knife is advisable. When suppuration threatens, the warmth of a poultice or hot fomentation with or without the application of leeches may sometimes arrest it; a blister at times also seems to check its progress. When pus has formed it is wise as a rule to let it out, but the surgeon should be in no hurry to do this unless the pain is great and the abscess has a disposition to spread, as pus may be re-absorbed, and opening a periosteal abscess renders bone exfoliation more probable.

Chronic ostitis is an affection most troublesome to treat with any effect, and the same means that have been recommended for periostitis may be tried in this. In a general way, however, they do little more than give relief and have but slight effect on the progress of the disease, it being far too common for a bone in a state of chronic inflammation to become necrosed. When treated early, however, success is not unfrequent. When the disease is steadily progressing and remedies appear to have no influence on its progress, the operation of drilling the bone in one or more points according to the extent of the disease, is an operation to be recommended; when this fails, that of trephining may be employed, for if taking away a piece of bone or drilling it does not arrest the disease, which it undoubtedly often does, it at any rate gives relief to local pain. Pain in endostitis or periostitis is due to tension caused by pent-up inflammatory effusion, whether fibrinous, purulent, or serous, and relief can only be afforded by its removal. When a new growth, cystic or otherwise, occupies the centre of a bone, a like pain is however experienced.

Necrosis

means the death of bone, the result of periostitis or endostitis, and it may be of the shell or compact tissue, of the inside or cancellous tissue, or of both combined. It may occur idiopathically without known cause, or as the result of fever, injury from sprain, concussion, contusion, fracture, or gunshot wound. As a consequence of acute inflammation, bone may die rapidly. I have already related a case in which local necrosis of the articular extremity of the tibia took place in six weeks, and it is well known that phalanges necrose and exfoliate in five or six; in fact, in acute necrosis, a month or six weeks is full time for bone to die and be thrown off. In the necrosis of the lower jaw from phosphorus, the same truth is exemplified. When a bone dies from inflammation, it does so usually from the acute form; the chronic action being shown in the process of exfoliation, *i. e.*, in the separation of the dead from the living bone; for in this process, a considerable time is often expended, no definite period having been hitherto recognized, as its rapidity differs in every case.

The process of exfoliation is a very beautiful one and is the same in bone as in the soft parts, only slower.

"When a portion of bone is to die," writes Holmes in an admirable article in his 'System,' vol. iii, "the first phenomena is the cessation of circulation in it. This leaves it hard, white, and sonorous when struck. It does not bleed when exposed or cut into, and is insensible. Occasionally, when the dead bone is exposed to the air, and acted on by the presence of putrid pus, its color becomes nearly or quite black; large surfaces of hard, black, necrosed bone are sometimes left exposed by the sloughing of the skin over the tibia. The dead bone at first retains its connection to the bone around, as well as to the periosteum or whatever part of the nutrient membrane may belong to it; but the presence of a dead part is never long tolerated by the living tissues, and accordingly the processes which are to eliminate it soon become perceptible in both these structures. The periosteum or medullary membrane, as the case may be, separates from the dead bone and becomes inflamed, a quantity of ossific deposit (more or less, according to circumstances) is poured out between it and the dead bone, and this deposit soon becomes converted into new bone, forming a sheath over the dead portion, by which the latter is inclosed or *invaginated*, as the technical term is. The dead part is now called a ***sequestrum***, a name only properly applied to it when loose and invaginated, though often incorrectly used of any piece of dead bone. While this sheath is being formed from the membrane coating the dead bone, changes are going on in the living bone to which it was attached. When the latter has been previously diseased, *i. e.*, when the necrosis has been of inflammatory origin, the inflammatory deposit which surrounds the sequestrum softens, pus is formed, and a groove of ulceration is produced at the expense of the circle of inflamed bone which forms the margin of the sequestrum. If the surrounding bone has been previously healthy the sequestrum acts as an irritant upon it, setting up first inflammation and thickening to a variable distance, and then ulceration. Thus a groove is traced round the sequestrum, and the formation of the groove is accompanied by suppuration, 'the pus containing much earthy matter from the disintegrated tissue, B. B. Cooper stating 2½ per cent. of phosphate of lime.' The pus formed in the neighborhood of the dead parts makes its way to the nearest surface, and in so doing interrupts the formation of the periosteal sheath, leaving sinuses or *cloacæ*, passing through this sheath from the sequestrum to the surface of the body, or sometimes into a neighboring joint or serous cavity. The presence of such sinuses leading through the shell of bone to hard, smooth, sonorous bone at the bottom of the cavity is the distinguishing mark of necrosis" (Fig. 575).

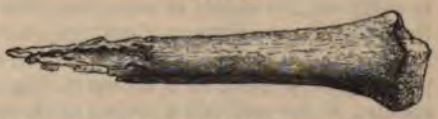
Where the periosteum has been destroyed, no investing sheath of bone will exist to interfere with the separation and casting off of the sequestrum (Fig. 576); where it is nearly perfect, the shell of new bone will be complete (Fig. 574). Under these circumstances, the casing thickens and becomes dense. To reach the sequestrum in the thigh, I have cut through a bony sheath upwards of an inch in thickness. The subperiosteal sheath is never seen in necrosis of the skull or in short cancellous bones.

The whole shaft, or any portion of a long bone may become necrosed, the epiphyses often saving the joints (Fig. 576); but as a rule some portion of the shaft remains attached to one or other of the epiphyses. Occasionally the epiphyses themselves are the seat of necrosis. In the tarsal bones during infant life, the ossific centre of the bones may die and exfoliate. There is also good reason to believe that necrosis of the shaft of a bone often originates after a sprain or injury, from inflammation in the epiphysial cartilage connecting it with the epiphysis.

The amount of thickening around the sequestrum depends much upon the extent of new bone poured out by the periosteum and the duration of the process; its density also turns upon the length of time the sequestrum has been invaginated, and the character of the inflammation. The bony shell in its early condition is soft and readily cut, broken down, or peeled off; in its later stages it becomes almost as hard as ivory, and is most difficult to cut.

When the cloacæ of the bone case are large and fortunately placed towards the end of the sequestrum, natural efforts may be sufficient of themselves to get rid of the foreign body, the granulations filling the cavity gradually pressing upon the dead bone, and mechanically extruding it from its bed. In this way, large masses of bone are sometimes discharged by natural processes. After amputation, this result is frequently seen. Some years ago, I saw with Mr. Cock and Dr. Iliff, of Kennington, a case in which the upper part of the shaft of the humerus which had separated at its upper epiphysis, was gradually pressed out from below through the deltoid muscle and projected outside the acromion process for about an inch; Mr. Cock had only to complete the process which nature had so well commenced, and draw out the bone, which was four inches long (Fig. 581).

Fig. 581.



Upper half of the shaft of the humerus thrown off at its junction with the upper epiphysis by natural processes. Prep. 1104^{60}.

Every surgeon is familiar with a somewhat similar act in other cases where large pieces of bone, and far more frequently small ones, are sometimes discharged by natural processes; but such successful natural efforts are rare in comparison with the failures, surgical art being demanded, as a rule, to assist in a cure.

When the dead bone has been shed, the sequestrum extruded by natural efforts or removed by surgical skill, the bone granulates and thus heals. When this process takes place upon its surface, the steps are very visible, and when the sequestrum has been removed from a cavity, the same process goes on, but with it another acts with equal force, and that is the gradual contraction of the periosteal shell of new bone that surrounds the sequestrum. A bone in this way is re-formed and repaired.

Treatment.—When the presence of dead bone has been made out, its removal is the only sound practice, since the longer it is left in its cavity, the thicker and denser will become the periosteal bony sheath, consequently the probabilities of a natural cure are lessened, and the difficulties of a surgical operation greatly increased. The sequestrum, however, cannot be taken away until it has been thrown off or loosened from the living tissues; although as soon as this result has been effected, the sooner the operation for its removal is performed the better. To interfere too soon before this process has been completed is sometimes injurious, and always futile; to wait too long is simply to add to the difficulties of the case and to postpone recovery. Bones that are not loose may, however, often be detached by a good twist with a pair of forceps, or raised by an elevator.

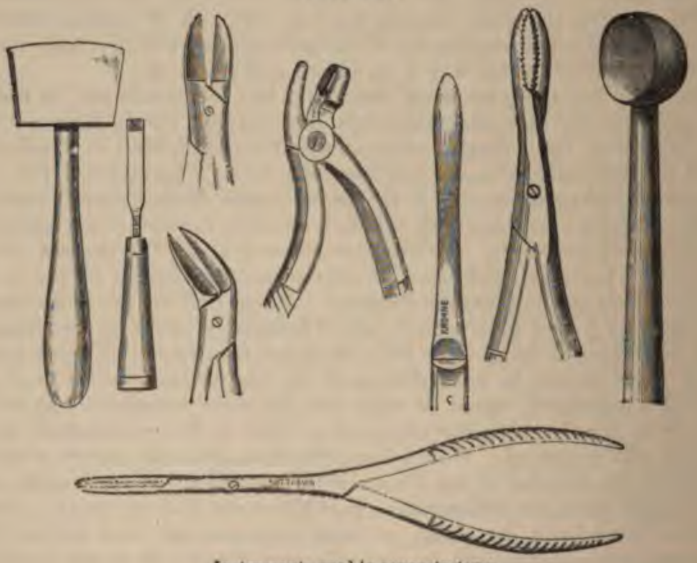
When the dead bone is found to be loose by means of a probe, by being made to move in its sheath, there should be no hesitation on the part of the surgeon as to interfering; though when this movement cannot be made out, the same treatment may be justifiable, as the sequestrum may be so tightly impacted or shut in by granulations, as to be immovable though still separated. Under these circumstances, the history of the case and more particularly the duration of the disease will be of great help as a guide, for if many months have passed since the inflammation that killed the bone set in, the probabilities of the sequestrum being loose are great, as most sequestra are shed in four, five, to ten months. I have seen a sequestrum in acute diseases thrown off in six weeks, and have removed a large portion of the shaft of the tibia three months after the first onset of the symptoms; while, on the other hand, the dead bone may be found fixed at a far more distant date than that named. All know that a necrosed phalanx is generally loose and ready for removal at the end of five weeks, and in most cases the surgeon is justified in performing the operation for necrosis (sequestrotomy) within the year. English surgeons, as a rule, are disposed to wait till the evidence of the sequestrum being quite loose is clearly marked; whilst many Continental surgeons, and particularly the German, excise diseased bone within three months of the first manifestation of disease, by what is called a sub-periosteal operation, that is, the peeling off of the periosteum, and the resection of the shaft of inflamed, dying, or dead bone. But in doing this, as nature has not yet indicated the limit to the disease, nor separated the dead from the living bone, much good bone must of necessity be often removed with the diseased, or much of the diseased bone left behind, both of which are undesirable objects. In English practice the cure is postponed and the difficulties of the operation are increased. In the Continental more may be done by operative interference than is needed or less than is required, the new formation of bone by the periosteum at the same time being necessarily interfered with.

The best practice, probably, is to be found between the two, and that is, surgical interference about three to six months after the first appearance of symptoms; in acute disease, and in small and narrow bones early, but in chronic disease, and in large and thick bones late interference.

The Operation of Sequestrotomy.

There is no operation in surgery more satisfactory than this, as it is usually unattended with danger and followed by complete success. In many cases it is simple, while in others it is complicated, the ingenuity of the surgeon being often taxed to devise means to carry out the object in view, viz., the removal of the sequestrum. Taking as a type of the affection, the tibia in which the whole shaft or diaphysis is the seat of mischief, many cloacæ, or fistulæ, leading down to the dead bone through the periosteal bony case will probably be present, as is shown in Fig. 575; and with a probe introduced through an opening at one end and a second at the other, the surgeon may make his incision between the two down to the bone—that is, down to the new case of bone that envelopes the old—and having done this he may peel back the periosteum with a raspatory or periosteal retractor, cut through the new bone that prevents the dead from being seized, by means of forceps or chisel, and thus expose the necrosed shaft. The dead piece may then be seized by a pair of sequestrum forceps, and, where practicable, withdrawn. Should it be too long to extract through the wound, or should the opening in the bony case correspond to its centre, the sequestrum may be divided with a pair of cutting forceps, and its two halves separately removed. At times a good elevator is of use to raise the sequestrum from its bed, or to prize it from its attachment. Occasionally a good deal of the new casing of bone requires removal before the surgeon can get at the dead portion; and in the femur where the whole shaft is necrosed, the upper part being larger than the lower,

Fig. 582.

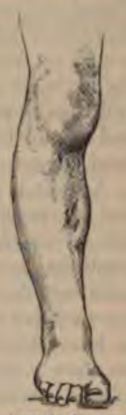


Instruments used in sequestrotomy.

it may be necessary to chisel off or remove nearly the whole surface of the new shell of bone to admit of the removal of the sequestrum, it being impossible to withdraw through the lower orifice a piece of bone of larger diameter. In one case, the simple enlargement of one of the cloacæ may be sufficient to enable the surgeon to seize and remove the bone; while in another, it is necessary to lay two or more cloacæ into one. The operation should be done with as little interference with the soft parts and bony sheath as possible. The object having been obtained, the parts have only to be kept clean, raised, and left alone to fill up and heal, when a good recovery will generally follow. The instruments employed for sequestrotomy are illustrated in Fig. 582. In all cases, Esmarch's elastic tourniquet should be employed to prevent hemorrhage.

When the whole shaft of a bone has been removed in early life, some shortening of the new bone or arrest of growth may be looked for, and in the case (Fig. 583) such a result took place. The drawing was taken from a young woman, æt. 25, from whom, fourteen years before, I removed the whole shaft of the tibia. The bowing of the limb was due to the bending of the fibula, which had grown naturally and bent to adapt itself to the shortened tibia.

Fig. 583.



Arrest of growth of tibia after removal of dead shaft fourteen years before.

When the sequestrum cannot be raised from its bed, it had better be left alone, the opening made not being lost, as through it the sequestrum may subsequently be taken away or expelled naturally.

Dead bone, the result of periosteal disease, that is not covered in by new bone, readily exfoliates, and rarely requires more than its simple removal by forceps, the soft parts covering it being divided; in this way, large portions of the skull may be removed. I have taken away nearly half the frontal bone in a child, and also in an adult, after syphilitic periostitis, large portions of all the cranial bones forming the vault. In one case, large portions of the parietal, occipital, and frontal bones were removed.

When after necrosis of a bone the sequestrum presses upon an artery, fatal hemorrhage may ensue. Thus, Poland has recorded ('Guy's Hosp. Rep.') three cases where such a result took place in necrosis of the femur, the popliteal artery in each having been wounded. Holmes has also recorded a case where a fatal hemorrhage from the lingual artery followed disease of the jaw, and from the aorta in caries of the spine. A preparation in the Guy's Museum (1243^{30}) also shows a piece of necrosed tibia that perforated the anterior tibial artery and set up hemorrhage, necessitating the application of a ligature to the femoral artery.

When necrosis occurs in a joint, profuse suppuration and disorganization must ensue. Where this does not prove fatal and repair goes on, recovery may be prevented by the presence of diseased bone; and when this can be detected its removal is the best practice. I have done this in the knee in three cases, and in the hip, ankle, shoulder, and elbow-joints with good result, having in all removed large pieces of dead bone through a sufficiently large incision. ('Lancet,' Feb. 6, 1875.)

Such cases as these must be looked upon as cases of necrosis, the joint having lost its special features by previous disease.

Necrosis of the carpal and tarsal bones is a common affection, for these bones die like the flat bones, no new sheath of bone preventing their exfoliation or removal. They may be treated freely, such incisions being made as will allow of their removal. The os calcis is the bone most commonly affected, and I have removed a large portion of it on many occasions with complete success. The epiphysis of the heel is not rarely affected. The scaphoid is sometimes involved, even at a very early period. The cuneiform and cuboid, separately or together, are also found diseased. Not long ago, I removed from a boy's foot by two incisions, the whole row of these bones, and an excellent foot was left—so good, indeed, that it was difficult to believe that so much bone had been taken away (Fig. 551). The same may be said of the carpal bones. Indeed, in these cases true conservative surgery is of great value. The removal of dead bone, however extensive, is a very safe operation, and followed by results which are often startling by their success. There is no limit to the removal of necrosed bone, wherever found, nor to the amount of natural repair. To amputate a limb, foot, or hand, for necrosed bone until the surgeon has proved that the removal of the diseased part is impossible, or the simple removal proved unsuccessful, is scarcely a justifiable proceeding.

To gouge away bone that is inflamed and not dead, or to excise inflamed bones that may undergo repair, is a proceeding which is practically bad and scientifically unreasonable; for all bone that is not dead is reparable, and to interfere with it mechanically is bad surgery.

The great success of the operation for necrosis (sequestrotomy) is unquestionably due to the introduction of anæsthetics. Prior to their introduction the operation was difficult and dangerous, indeed, it was rarely performed, amputation having been too often substituted.

Caries.

No word in surgery has been used with greater carelessness and with a greater variety of meanings than caries, nor is there one that conveys now a less definite idea. In this section it will be applied to an unhealthy inflammation of bone, chiefly of cancellous bone. When superficial, it is often associated with ulcerative or molecular death, when deeply placed or central, with necrosis or suppuration, and may or may not be associated with syphilis or struma. It is *pathologically* remediable and reparable, and whenever found is mixed up with reparative processes. In patients of feeble power and some constitutional cachexia, or where the disease is very extensive, it may, however, *clinically* be incurable, and thus require surgical interference. Nevertheless, in its nature it is inflammatory, and should be looked upon as a curable affection, depending more upon constitutional than local causes. In this respect differing from necrosis.

A bone is said to be *carious on its surface* when being exposed it presents an irregular and worm-eaten appearance, and is suppurating, and the sore throws off a serous, more or less offensive, purulent discharge, which contains excess of phosphate of lime, mixed with small fragments of bone tissue. This affection is generally associated with an ulcer or open sore of the skin over the parts, and more or less thickening of the periosteum and bone around and beneath the diseased portion. It is always vascular, and readily bleeds on being touched. It is occasionally painful. At times the bone is soft and yields to the pressure of the probe; in other cases it is hard. When it attacks the articular surface of a bone it often forms pits with sharp well-defined edges, and under these circumstances has been looked upon as scrofulous, but with what amount of truth it is difficult to say. When it is associated with syphilis it follows the suppuration of a node. At times it is complicated with the tubercular thickening of the surface of the bone itself, or with what Paget has described as annular ulcers, in which a spot of ulceration is seen which goes on to form a circular trench round a worm-eaten surface. This trench increases in width and depth, and at last loosens a sequestrum, which separates and leaves a circular depression. In bones of the skull this ulcer may involve one or both tables. *This ulcer* may subsequently heal, leaving a permanent depression. "*Caries*," in fact, is inflammation and ulceration of bone, "*necrosis*" is its death *en masse*.

A bone carious in its interior is vascular, although softened sometimes almost to rottenness, and easily breaks down; it discharges often a thin, sanguineous, fetid, semi-purulent fluid, which contains fragments and elements of bone; abscesses which generally communicate externally through the soft parts often coexist in and about the bone, and are occasionally combined with necrosis. In the spine, where it is the more commonly met with, it is often unassociated with any external suppuration or discharge, though the bone with the intervertebral substance softens down and undergoes extensive molecular death; much loss of bone taking place, the particles being apparently reabsorbed and carried away, and complete recovery following without any external discharge. Around the inflamed or carious bone the cancellous tissue is generally infiltrated with more or less organizable inflammatory lymph, the character of which depends much upon the character of the inflammation. In feeble and strumous subjects, the fluid will be of a serous, oily, and non-plastic kind ('Black on Tuberculous Bone,' Edin., 1859), the cancellous bone becoming more cellular and lighter. In more healthy types, the effusion will be plastic and organizable, the bone becoming more compact. In one case no consolidation of the surrounding bone will be present, while in another, condensation of the bone to a greater or less extent will be found.

Under all circumstances the nature of the inflammatory action turns much upon the constitutional power of the patient; the disease tending in strumous and feeble subjects to widen but not to repair, while in more healthy subjects it inclines to a local action and recovery.

In rare examples, genuine tubercle may coexist with the inflammation.

Treatment.—Looking upon caries as an inflammatory affection and consequently as curable, it is to be treated on somewhat similar principles to inflammation of other parts.

When the general powers of the patient are feeble, they ought to be stimulated by tonic medicine and regimen; local pain to be soothed and torpid action stimulated, but all mechanical and surgical interference should be avoided, except for the removal of dead bone. In superficial or periosteal caries or ulceration, when rest, elevation, soothing or possibly stimulating applications with tonics fail to induce a healthy reparative action, local stimulants are sometimes of use, and the application of such mineral acids as the nitric or sulphuric, strong or diluted, has often a beneficial action. Pollock speaks highly of the value of sulphuric acid, at first diluted with equal parts of water and subsequently pure, the acid destroying the diseased bone to which it is applied, and setting up a more healthy action in the parts beneath, thus hastening recovery. Boinet advocates the use of iodine, at first diluted and then strong; others recommend phosphoric acid. Dr. Fitzpatrick applies the Vienna paste or potassa cum calce to the surface of the inflamed bone, as well as to its deeper parts after puncturing them. The actual or galvanic cautery has also been employed, and in superficial caries seems to be valuable. In deep-seated or endosteal caries, some speak highly of operative interference, either by the gouging out of the diseased tissue or excision of the inflamed or carious bone; but I allude to this treatment only to condemn it, since I believe it to be both unnecessary and injurious. It is unnecessary, as in the majority of cases recovery can be secured without it; it is injurious, since gouging, as a rule, adds to the irritation, and thus tends to spread the disease, and often excites more general inflammation in the bone or endosteum.

Excision of the diseased bone is not an operation that can be highly recommended; yet it may be done, doubtless, with success, as in the tarsus, and many an inflamed or carious os calcis has been successfully excised. There is, however, a strong question as to the necessity of the operation. When the bone dies, the necrosed bone may and should be removed, but in all other conditions, it is reparable under constitutional treatment and local applications. Surgeons who interfere surgically with carious bones usually prefer excision to any partial operation. Superficial or periosteal caries may be regarded and treated as an indolent ulcer in other parts, the repair being more chronic in bones than in soft tissues, and deep-seated caries or inflammation may be also considered much in the same light. When syphilis complicates the case, iodine in full doses, in one of its forms, and as a local application, is of great use, combined with any tonic that may appear to be needed.

TUMORS OF BONE.

Tumors of bone vary but little in their pathology from tumors of other parts, and whatever differences exist, arise from the peculiarity of the tissue in or around which they grow. Tumors of bone, as of soft parts, partake of the nature of the tissue in which they are developed; thus, a tumor that in a fibrous organ would be more or less fibrous, when originating in or upon a bone is mixed with bone, and a carcinomatous tumor of soft parts becomes a malignant osteoid cancer of a bone. In addition to these, there are special tumors known as the myeloid, and the cartilaginous.

Excluding, therefore, enlargements of bone due to inflammation, there are bony outgrowths or *exostoses*, *cartilaginous* and *myeloid* tumors, all being, as a rule, of an innocent nature. There are the *osteo-sarcomatous* tumors, or fibrous tumors of bone, including those that have a periosteal as well as an osteal origin, the fibrous and osseous elements predominating in various degrees; and, lastly, there are the *malignant tumors of bone*, whether of the soft or the hard kind, osseous matter being mixed up largely with both; the disease acquiring the name of osteoid cancer when the bony elements predominate. These tumors grow from the periosteum as well as from the bone.

Exostoses may grow from almost every bone; from the cranium inside and out, as well as from the bones of the trunk and extremities. Those of the cranium are usually very dense and of ivory-like hardness; indeed they are often called ivory exostoses, and sometimes are so hard that they cannot be removed. They may have broad bases, but at times are pedunculated, and in singular examples they occur as loose growths; these latter have generally occurred in the frontal sinus and should be described as *enostoses*. Mr. Hilton has recorded an interesting case ('Guy's Rep.,' vol. i), in which such a bony tumor, of twenty-three years' standing (Fig. 585), fell out of a large cavity in the superior maxillary bone (Fig. 584). The man in 1865, thirty years after the operation, was well, although disfigured by the hole in which the tumor had rested; and in a former page (page 526) I have recorded a case of the same affection and figured it (Figs. 306–7). These bony growths are more common about the orbit and air-cells of the head than elsewhere. True ivory exostoses of these parts do, however, occur, and at times attain a large size. Birkett has related ('Guy's Rep.,' 1868) such a case of Dr. V. Bruns's, in which an ivory tumor of seventy-four years' existence, weighing ten pounds, grew from the occipital bone of a man, æt. 80. Exostoses from the jaws, or rather alveoli, are often called "epulis."

FIG. 584.

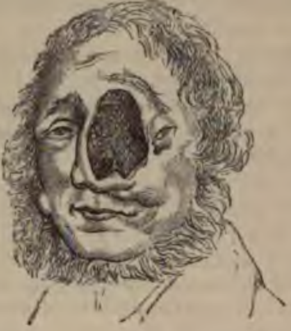
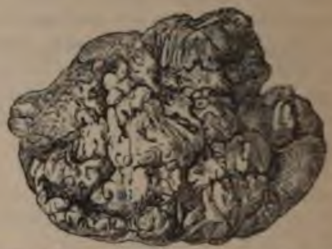


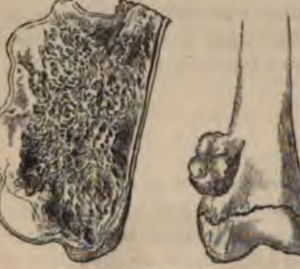
FIG. 585.



Tumor as discharged from cavity in Fig. 584, weight nearly 15 oz., circumference 11 by 9 inches. Mr. Hilton's case. Prep. Guy's Mus., 1666^{80}.

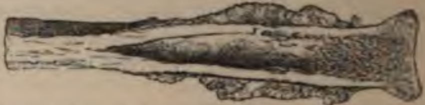
Exostoses on the extremities are not uncommon and are apt to spring from the point of junction of the shaft with the epiphysis (Virchow considering this as the usual seat), and at the attachment of muscles. They are mostly outgrowths of bone capped with cartilage by which they grow (Fig. 586); exostoses, however, of long standing have an osseous shell. They have at times broad bases, but more frequently narrow peduncles. They are often curved or crested, assuming odd shapes, and may grow to a large size. In exceptional instances, they may die or necrose without any known cause, and as a result of accident they may be broken from their attachment. I have seen this in an outgrowth from the femur of a girl, æt. 12, who received a kick from a donkey; and, in a second case, a patient of Mr. Birkett's, with an exostosis of the tibia. When broken off from their bony attachments they may in exceptional instances wither, but, as a rule, they will again adhere. In a patient of Mr. Maunders, in whom an exostosis of the femur was subcutaneously separated from the bone, adhesion took place, although at a better angle. At times, exostoses are multiple. In a girl, æt. 16, I found exostoses of different sizes on both tibiæ and both hands, one humerus, one radius, and ilium; and in two patients, 9 and 16 years of age, respectively, five bones were so affected.

FIG. 586.



Exostosis of the femur.

FIG. 587.



Periosteal exostosis. Prep. 1114^{80}, Guy's Hosp. Mus.

Some exostoses have a *periosteal* origin, the result of organized inflammatory products; when they are usually diffused. Fig. 587 shows this well, and was taken from a patient of my father's, the late Mr. T. E. Bryant.

Ungual exostoses deserves a special notice, since they are even now too often mistaken for what is called an ingrowing toe-nail. They are generally found on the distal phalanx of the great toe (Fig. 56, page 143), but Prep. 1287, Guy's Museum, shows a specimen from the little toe, and I have had under my care two cases in which an exostoses grew from the ungual phalanx of the thumb, and one in which it was attached to the index-finger. Liston, in 1825, first drew attention to the nature of these cases.

The osteophytes and the outgrowths of osteo-arthritis are not classed amongst the exostoses.

TREATMENT.—When surgical interference is called for, nothing but the removal of these growths can be entertained, their bases being well levelled down to the bone or even scooped out. When, however, they are placed near joints, this practice should be well considered. In a case in which an exostosis projected from the inner condyle of the knee I divided its base subcutaneously with a chisel, and pressed it back into the popliteal space, where it remained without giving trouble. In cranial exostosis, this operation may not only be difficult, but impossible; still the attempt, wherever it can, should be made, for many successful attempts have ended in procuring the death of the exostosis and its subsequent exfoliation. In such a case, treated by Mr. Cock, where the removal of the whole from the orbit was impossible from its hardness, a part was removed, and what remained subsequently died and sloughed out.

Intra-cranial exostoses are rarely made out during life, and are at times associated with epilepsy.

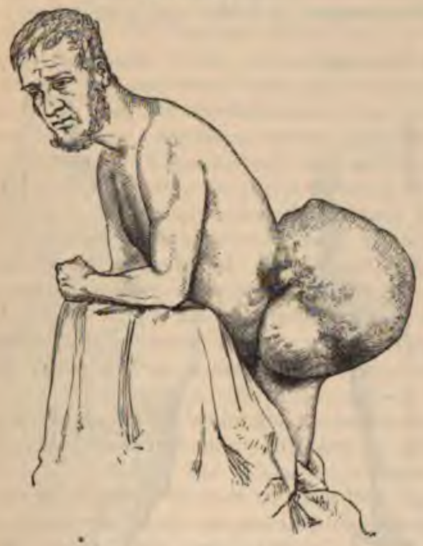
The following analysis of 120 cases of exostoses will show the seat of these growths. 45 were tabulated by my colleague, Mr. Birkett, in 'Guy's Reports;' and the remainder are from my private notes. Cases of epulis are excluded.

Frontal bone	3	Clavicle	3	Tibia	18
Upper jaw	1	Humerus	15	Fibula	4
Lower jaw	3	Ulna	1	Patella	1
Bodies of cervical vertebræ	1	Radius	2	Tarsal bone	1
Sacrum	1	Fingers	5	Metatarsal	1
Ribs	3	Ungual phalanx of thumb	2	Ungual phalanx of great toe	25
Ilium	1	Femur	18	Sole of foot	1
Scapula	10				

Three of the cases tabulated were examples of multiple exostosis; when the radius was affected, it was in common with other bones.

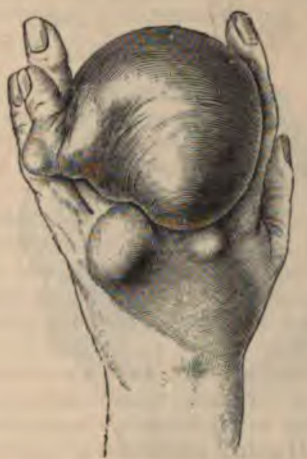
Enchondromatous or cartilaginous tumors of bone are most commonly met with in the phalanges and metacarpal bones. They are, however, seen surrounding bones having a periosteal origin, or growing from the bones of the upper jaw. A remarkable instance of this has been recorded in Chapter XIII, and figured in Fig. 218. It would appear that such cartilaginous tumors are more prone to attack the scapula than any other bones, and I have seen several such cases. Mr. Birkett has recorded and figured a fine specimen in the 'Guy's Reports,' 1866.

Fig. 588.



Enchondroma of pelvis.

Fig. 589.



Enchondromatous tumors. From a model in the Guy's Museum.

The bones of the pelvis are at times the seat of such growths. I have the records of a remarkable instance in which the pelvic surface of the ilium was the seat of the affection, and of another in which a middle-aged woman had an enormous cartilaginous outgrowth, the size of a cocoa-nut, springing from the pelvis, and occupying the inner side of the right thigh beneath the adductor muscles.

The case from which Fig. 588 was taken occurred in the practice of my friend, Mr. Knaggs, of Huddersfield. It was of twenty years' growth. Cartilaginous tumors of bone usually originate in it, and are found in young subjects when the bone is growing. They are generally covered by a shell of the bone in which they originate, the cartilage at times expanding it in all directions, but more usually in one. In Fig. 589, taken from a model in Guy's Museum, this mode of growth is seen. In Fig. 21 the section of such a growth is well illustrated.

Cartilaginous tumors are usually of slow growth and painless, with a smooth outline. At times they undergo decay and soften down, discharging a brown-colored serous fluid unlike any other tumor; and under such circumstances are prone to disseminate like cancer. At other times they ossify and turn into bony tumors; the "bulbous exostosis" being often an ossified enchondroma.

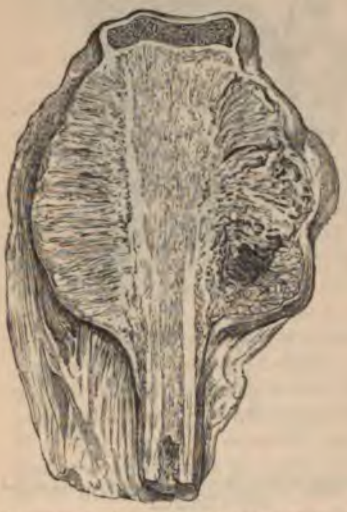
TREATMENT.—Where a cartilaginous tumor can it should be scooped out of a bone, and in the phalanges and metacarpal bones this practice is usually successful. Extreme examples of the disease demand amputation or excision of the affected bone.

Enchondromatous tumors are at times recurrent, and in rare examples, return as malignant tumors in other parts of the body. Such growths having a periosteal origin are usually rapid in their increase and diffused. True cartilaginous tumors of bone are usually circumscribed and often multiple. The bones of the hand are at times much involved.

Osteo-sarcoma is a term of broad signification, and usually applied to the fibrous tumor of bone in which fibre-tissue and bone elements predominate in various degrees. Wilks believes "that they are altogether comparable to the fibrous tumors of soft parts." They usually have a periosteal origin—periosteal sarcoma—and even in exaggerated examples the shaft of the affected bone may clearly be traced through the growth. The tumor is usually circumscribed with a fibrous capsule, and divided by fibrous or ossific rays into different portions; at times the fibrous element predominates, at other the osseous. The disease is usually seen attacking the ends of the shafts of bone and not the epiphyses. All these points are well seen in Fig. 590.

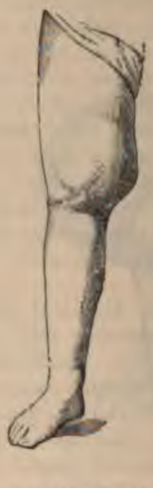
Cartilage is often found to be mixed up with the fibrous and osseous elements; and in proportion to the amount of bone matter entering into the formation of the tumor it may be regarded as innocent or otherwise; bony pericsteal growths are rarely cancerous. When fibrous tissue, and more particularly the softer forms, predominate, the tumor is prone to recur at the same spot, or in some other organ, as is the case with cancer.

FIG. 590.



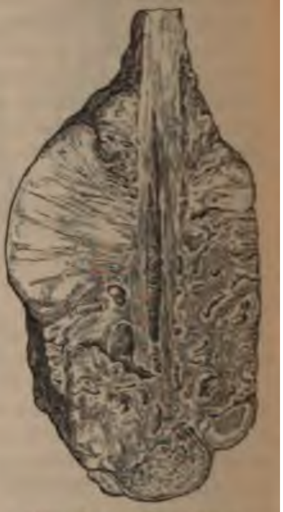
Periosteal osteo-sarcoma. Drawing 20, Guy's Hosp. Mus. Key's case.

FIG. 592.



Appearance of limb affected with osteo-chondroma.

FIG. 591.



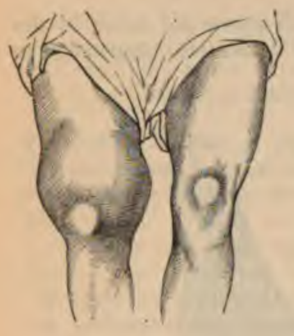
Osteo-chondroma of femur. Drawing 5^{84}.

Osteo-chondroma is applied to a tumor involving bone, and made up of cartilage and bony elements in variable degrees, the cartilage taking the place of the fibrous tissue of the osteo-sarcomatous tumor. In one case bone will predominate, in another, cartilage.

The disease is usually of slow growth and simple in its nature. In the case of a woman, æt. 34, from which Fig. 591 was taken, the disease had existed for three years. Fig. 592 represents the same tumor taken during life.

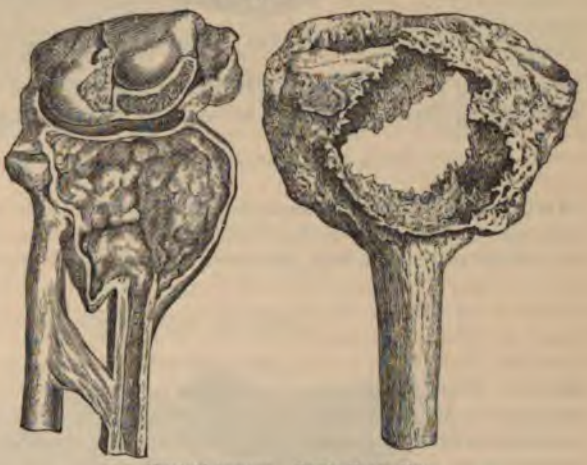
Myeloid tumors of bone are probably innocent, exceptional instances being on record in which a return in the part or in internal organs took place. They usually attack also either the epiphyses or epiphysial ends of the shafts of bones (Fig. 593). I have seen the disease, however, involving the shaft of the radius and upper jaw, and Paget has described it as attacking the breast. It begins commonly in the centre of the bone which it expands, forming a globular shell of bone, the spina ventosa of the older writers (Fig. 594). The interior of this shell is made up of fibre-tissue, or, it may be cystic, the cavity being divided by means of fibrous septa into more or less well-marked cystic divisions. The spaces themselves, or loculi, contain the characteristic myeloid material, "an opaque white, intermixed with a semi-transparent gelatinous-looking substance of a *cherry red color*," and their substance is made up of the characteristic polynucleated and irregular myeloid cells (Fig. 29).

FIG. 593.



Expansion of condyles of femur from myeloid tumor.

FIG. 594.



Myeloid tumors. Guy's Hosp. Mus.

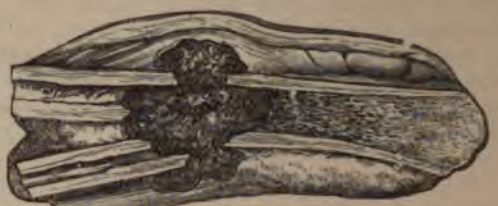
When the tumor encroaches on the joint the cartilage is usually spread out over the tumor, but intact. These tumors were originally mixed up with the cancerous or fibroplastic of Lebert. They are found likewise in the gums as "epulis," and in other parts. In a specimen of myeloid tumor of the upper jaw which I removed from a girl, æt. 8, the structure was very dense ('Guy's Rep.' 1873–4–7).

Cancers of bone as of other parts show their malignancy in involving the utter destruction of the bone in which they are developed. They may originate in the periosteum or in the bone, but in either case both tissues will be eventually affected. When they originate from the periosteum, the bone may be found in parts running through the mass and the cancerous elements surrounding the shaft (Fig. 596), but when the disease has existed for any period, the same cancerous elements will be found in the shaft itself and destroying it. When the disease begins in the bone, it is usually in the medulla by one or more different centres, and these by their increase, expand the bone and utterly destroy it (Fig. 595). The bones under these circumstances are very brittle and apt to break on the slightest force, even by ordinary muscular action, the fracture probably being the first indication of the presence of the cancerous disease. I have known fracture to occur under these circumstances by a patient turning in bed, crossing a street, or walking down stairs. In the majority of cases of cancer of bone, bone elements have little to do with the disease, though in what is called the true osteoid cancer, masses of bone of a condensed kind appear in the medulla, and gradually grow until a large osseous mass of disease is formed.

In Fig. 597 this form of disease is well seen, and was taken from a patient of Mr. Aston Key's, æt. 26, in whom masses of bone and cartilaginous tubercles were found in the lungs, pleura, and lymphatic glands after death.

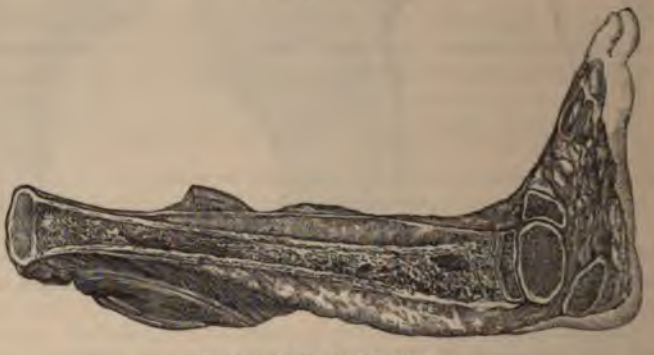
The *periosteal* form of cancer (Fig. 596) grows more rapidly than the endosteal or interstitial, and very quickly assumes a large size; and is not often accompanied by pain; the swelling is rarely globular in its outline, but loses itself both above and below in the surrounding parts; and in the integument covering it large full veins, from obstruction to the deep veins will likewise be seen. It will possess a semi-elastic feel, and often yield to the touch an unequal sensation as to density. *Endosteal* cancer is commonly attended with a dull aching pain, due to the expansion of the bone. Its increase is at first slow, but when it has so destroyed the bone as to have reached the periosteum, pain will be lessened, while the increase of the tumor will be more rapid. This form of cancer is more frequently secondary than primary.

Fig. 595.



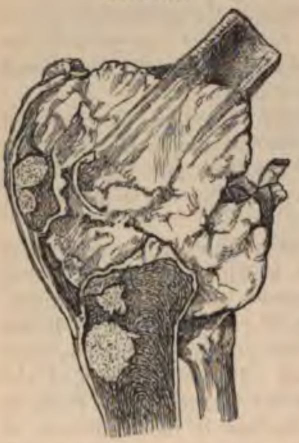
Fracture of the femur from muscular action at the seat of a local cancer in a man, æt. 25.

Fig. 596.



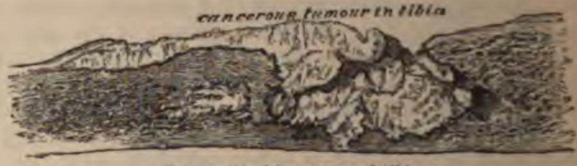
Periosteal cancer of the tibia.

Fig. 597.



Osteoid cancer of knee-joint. Prep. Guy's Hosp. Mus., 1165^{80}.

Fig. 598.

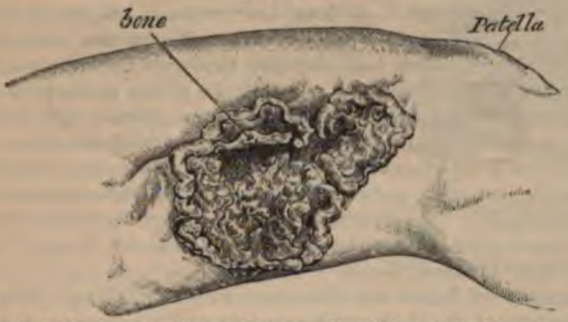


Cancer attacking necrosed tibia.

Primary cancer of bone or periosteum is more common in children than in adults.

Epithelial cancer may attack a bone by the extension of the disease from the soft parts, as seen in cancer of the lips; and skin cancer may also extend downwards into a bone of an extremity and cause great destruction. At times, a bone that has been the subject of necrosis may become the seat of cancer, and, within a short time, I had three such cases under care, in two of which the tibia was the seat of the disease, necrosis having existed in both for upwards of twenty years; and in the third, although the femur apparently became necrosed twenty-two years before the man came under my observation, the cancer evidently began in the skin over it, and extended down the sinuses into the bone. Fig. 599 was taken from the limb of this patient during life, Fig. 598 was taken from the limb after amputation at the knee-joint in another case. In a man I treated years ago, the os calcis and the soft parts over it were the seat of the disease, and the bone after amputation was found infiltrated with cancerous epithelial elements; and more recently (1878) I amputated the foot of a woman which had been the seat of cancer for twenty-five years, and of necrosis for ten.

Fig. 599.



Cancer of the skin spreading to the bone. From Edward Abrahams, æt. 42.

The Diagnosis of Tumors of Bone.

In most cases an approximation to truth can only be made.

A *globular* tumor situated in the articular end of a bone, and expanding it but not involving the joint, of slow, steady, and often painless growth in a young subject or adult, is probably myeloid. A more *elongated or ovoid* tumour situated in the shaft of a bone, of more rapid growth, with full veins in the soft parts covering it, and a semi-elastic, unequal feel, in a young subject, is probably a periosteal cancer. A *firm, fibrous growth*, of a somewhat globular form, of gradual increase and unequal surface, fibrous in one spot, bony in another, in an adult, is probably an osteo-sarcoma, while a more indurated growth with a botryoidal outline, and a similar clinical history, is probably an osteo-chondroma. Pain, rapid and diffused growth, with unequal density, glandular enlargement, venous obstruction, and wasting, generally indicate cancer.

Gradual, painless increase, a defined contour, globular, botroyidal, or in ridges, with no venous obstruction, glandular enlargement, or disturbance of the general health, usually indicate a benign tumor. The more globular the outline the greater the probability of the growth being myeloid. The older the patient and the more botryoidal the growth, the greater the chance of its being enchondromatous. The slower the growth, the more local and divided into septa, the greater the chance of its being osteo-sarcoma.

When a tumor is periosteal, by making firm pressure below the tumor, the bone will be made out to be on a lower level than the growth. When the tumor is endosteal and the bone expanded, on making firm pressure below the surface of the bone, the bone will be felt to rise gradually from the unaffected part over the surface of the growth so as to form a shell for it.

Treatment.—A tumor of bone can only be effectually treated by excision, and when it involves the articular end of the bone and encroaches upon a joint amputation is too often necessary. When the whole bone is involved as in a cancer, nothing but amputation can be entertained, and it is usually well to amputate high above the disease. If the tumor is placed in the head of the tibia, an amputation at the knee-joint may be performed, or, where this is inexpedient, just above the condyles. If the condyles of the femur are the seat of the disease the amputation should be at the centre of the shaft, it being justifiable to amputate at the hip-joint only when the disease is too extensive to allow of an amputation through the bone, for the hip-joint operation is most fatal and should be performed only when any less severe measure is impossible. In an evident cancer of the lower half of the femur, where amputation is to be performed, it had better be at the hip-joint, though in doubtful cases, the limb may be removed just above the growth.

In the upper extremity, however, where amputation at any of the joints is, as a rule, successful, it is wise in cancerous disease to remove the whole of the affected bone and amputate at the articulation above. In periosteal cancers the whole bone should always be removed. Amputation for myeloid and simple tumors are generally successful; and a young woman for whom I amputated the thigh for myeloid disease, in 1861, was still well seventeen years after the operation.

If a tumor involve the shaft of a bone, or the extremity of its diaphysis, but not the epiphysis, and the growth appears to be local and probably simple, an attempt should first be made to deal with it locally, to scoop or to turn it out, the more severe measure of excision or amputation being alone had recourse to should the minor fail. In the case of the enchondromatous and fibrous tumors of bone, the minor measure is usually successful. In fact, in the treatment of tumors of bone, when the disease can be removed without making any great sacrifice of other parts, the attempt should be made. Amputations as a primary measure should be reserved for clearly cancerous cases or diffused growths, or for such as involve the articular ends of the bones, and, consequently, the joint. Some interesting cases illustrating the advantage of excising portions of the long bones when the seat of myeloid and other tumors, have been recorded by Messrs. Lucas and Morris, in the tenth vol. of the 'Clinical Society's Transactions.'

Pulsatile tumors of bone are cancerous, as a rule, though they may be aneurismal. Cancerous tumors of the skull are frequently pulsatile, and in one well-marked case I had under care some time ago, in which the frontal bone was the seat of the disease, this pulsatile condition was its early symptom, the swelling being comparatively unnoticed. All pulsatile bone tumors have an interstitial origin and expand the bone, the new growth receiving its impulse from the large arteries that supply it. Gray ('Med.-Chir. Trans.,' vol. xxxix) has recorded an example of pulsating myeloid. True cases of *osteo-aneurism* are rare. Mr. Bickersteth, of Liverpool, has recorded such a case, and I had the pleasure of examining it carefully with Mr. W. Adams, and reporting upon it to the Pathological Society, vol. xix. It was, undoubtedly, a genuine case of this disease involving the tibia. Mr. Mapother ('Dublin Med.-Trans.,' 1863) has recorded another. These cases are made up of expanded bone from aneurismal dilatation of the vessels of the bone.

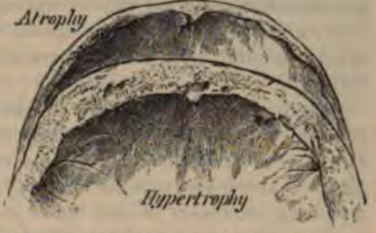
TREATMENT.—Pulsatile cancerous tumors of bone, like the non-pulsatile, ought to be treated by amputation; true osteo-aneurisms, of a limited size, when they can be made out, by local extirpation or by destroying them by means of the actual or galvanic cautery, and when very extensive, by amputation. Dr. Mapother cured his by the actual cautery, and Mr. Bickersteth by amputation.

Cysts in bone are occasionally met with, and may be serous, sanguineous, or hydatid. The two former are most commonly met with in the jaws, and in Chapter XIII, attention has been directed to them. Whether they ever occur in the long bones is an open question, though in 1870 I trephined the enormously enlarged and expanded shaft of the tibia of a man, æt. 30, for gradually progressive disease of fifteen years' standing; the bone having been the seat of a fixed pain in its centre. I did so under the impression that the case was one of abscess, but having perforated a dense shell of bone, an inch thick, I came upon a cavity the size of an egg, which contained *no* pus though it was lined with the soft velvety material usually met with in abscess, and what escaped from it was not to be distinguished from the blood that flowed during the operation. The operation was quite successful, and a rapid cure ensued. I believe this case to have been one of cyst in the bone.

Hydatids are found in bone, and in Guy's Museum there is the head of a tibia containing a cyst or echinococcus which holds many smaller cysts within it; also another specimen illustrating the existence of hydatids in the vertebræ. In 1869 I treated with Dr. Freund, a case in which a large hydatid escaped from the expanded condyle of the humerus after a puncture in front of the joint. The hydatid had clearly made its way from the bone into the elbow-joint, and through this externally; a good recovery with a stiff joint ensued.

Hypertrophy and atrophy of bone are pathological realities, although during life it may be a difficult if not an impossible task to recognize such conditions. Hypertrophies and chronic inflammatory changes are consequently often mistaken the one for the other, although in the former the enlargement is gradual and painless, and, in the latter, associated with local pain and other evidence of inflammation. In some cases the bone is enlarged and its cancellous structure expanded (porous hyperostosis); in another it is enlarged, but at the same time more dense (sclerotic hyperostosis). These changes are best seen in the calvaria (Fig. 600). In prep. 1068^{35} in Guy's Museum, the bone is at least double its normal thickness. In rare cases, the hypertrophy is clearly due to increase of function, as shown in another preparation in Guy's Museum, 1000^{15}, taken from a man who was a paralytic, and who had used his arms for progression, here the bones of the upper extremity are larger than those of the lower. In the majority of cases, however, the hypertrophy is inflammatory, and even in the case which Mr. P. Hewett mentioned in his well-known 'College Lectures,' where the man's skull increased so imperceptibly year by year as to be only recognized by the gradual increase in the size of his hat, the disease was traced to an injury.

Fig. 600.



Hypertrophy and atrophy of the bone From prop. in Guy's Museum.

This affection is pathologically interesting, though surgically nothing can be done for it.

Atrophy is most commonly met with in the shafts of bones that have not been used for many years, as in paralytic subjects and persons who have been the subjects of joint disease; in the bones of the aged, and in those that have been injured. The bone may become a mere shell, its cancellous tissue being expanded, and its cells filled with a fatty matter.

When atrophy follows injury, Curling's suggestion ('Med.-Chir. Trans.,' vol. xx) that the causes may be found in injury to the medullary artery is probably right. This probably happened in the case of a man who came to me with an ununited fracture of the humerus, in whom I found the bone on exposing its ends for operation to be a mere shell and not half its normal thickness. It, however, cannot be the only explanation, as Norris has recorded ('American Journ. of Med. Sci.,' 1842) a remarkable case, in which after a double fracture of the humerus about its centre, the whole bone disappeared, the forearm subsequently swinging as a thong, while the arm became shortened six inches; the bone disappeared "by the gradual action of the absorbents."

In these cases, spontaneous fracture or fracture from slight muscular action is very prone to occur.

These cases of hypertrophy or atrophy must not be confused with the elongation of the shaft of a bone which is due to inflammation, or to the shortening of a bone from arrest of its growth following disease or the removal of the shaft, or to some injury to the epiphysial cartilage that connects the shaft with the epiphysis; for it cannot be too strongly impressed upon the student's mind that any disease or injury which interferes in any way with the nutrition of the epiphysial cartilage through which the long bones mainly grow, will be followed by arrest of the bone's growth, and consequently, by the shortening of the limb; that is, when the disease or accident occurs in early life during the period of growth. I have before me the notes of several cases where this result ensued. In one in adult life, the tibia was an inch shorter than its fellow after the removal of a necrosed shaft in childhood (*vide* Fig. 583); in another, nearly the same amount of shortening followed an injury to the superior epiphysial line of the tibia; and in a third, the same result followed after a displacement of the lower epiphysis. In all these cases, the fibula was curved outwards, the shaft of the bone bent, and the outer malleolus much lower than the inner, the bone having grown as the others. In one case, the head of the fibula was partially displaced outwards.

Mollities ossium, or osteo-malacia is a rare affection, and its cause wrapped in obscurity. It is found in men in about one case in ten of the affection, and in women is usually discovered during, even if it does not originate in, pregnancy. It chiefly attacks subjects who, from some cause or other, have been subjected to prolonged depressing influences, more particularly upon the nervous system.

My colleague, Mr. Durham, in an able paper on the subject ('Guy's Rep.,' 1864), writes "that mollities ossium is to be regarded as a particular expression, as it were, of a general morbid condition of the system, rather than as a special disease of the bones themselves," and I believe there can be little doubt as to the soundness of the opinion. It should never be confounded with rickets, or with the fragility of the bones met with in the aged or demented.

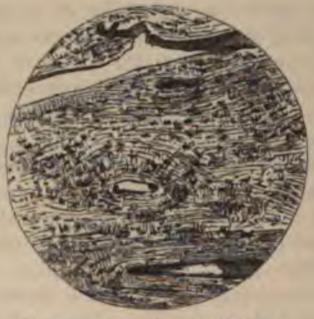
"The first symptom of the disease," writes Durham, "is pain, more or less peculiar in character, always deep-seated, and greatly increased by pressure or motion; sometimes coming on suddenly and with extreme severity, sometimes commencing vaguely and insidiously, and gradually becoming almost insupportable; sometimes wandering, at other times fixed for a period to some particular spot, and subsequently spreading to other parts; sometimes intermitting, at other times unceasing. In the majority of cases the pain appears to have been first felt in the lower half of the spine, the pelvis, and loins; but in some it commenced in the feet, knees, or other parts of the lower extremities; the pains are often looked upon as rheumatic. Associated with the pain there has always been noticed, on the part of the patient, at a very early period of the malady, a feeling of general lassitude and disinclination to do anything. This feeling has increased more or less uniformly until it has ended in actual inability to make any exertion whatever, and with the early local changes are associated an uncertain, feeble gait, and continual fear of falling."

Symptoms that are more or less directly associated with the softening and absorption of the bones are the next to appear, such as diminution of stature, deformity of the spine or pelvis, some curvature or fracture of one or other of the long bones, and, as time progresses, these indications multiply, *flexibility*, conjoined with fragility, being the distinguishing character of the bones in this disease.

The urine almost always contains a considerable excess of lime salts. The disease is rarely attended with any general or local symptoms of inflammation. The changes observed in the bones are carefully described by Durham. Increased vascularity appears to be an early symptom, the large grooves seen in the cranial bones being very striking; next, the bony matter is seen to be more opaque and less uniform than natural; sometimes it is irregularly granular, "as if some disunion must have taken place between the component elements of the bony matter."

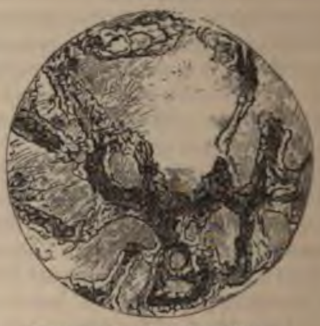
The lamination of the bones next becomes less distinct; the laminæ of the Haversian system appear more or less fused together; the bone-corpuscles become wider, although not with certainty more numerous. At a later date the earthy matter becomes absorbed; the Haversian canals become surrounded by a transparent ring of animal matter; which rings then become disintegrated and absorbed. By this process the Haversian system becomes destroyed, the bone assuming a hollowed-out, porous, or somewhat sponge-like appearance. The contrast between the healthy and diseased bone is well seen in Figs. 601, 601A.

FIG. 601.



Section of normal occipital bone.

FIG. 601A.



Section affected with mollities.

Durham, 'Guy's Rep.,' 1864.

The same changes occur in the cancellated as in the compact tissue. In the more advanced stage, the bone disintegrates rapidly; débris of tissue, such as the remains of bloodvessels, shreds of membrane, fat and oil-globules, with "marrow-cells," fill up the large spaces.

Chemically, the inorganic constituents are greatly diminished and chemical disunion and physical disunion coexist, the earthy matter being more readily dissolved out of the diseased than out of normal bone. "In healthy bone," writes Durham, "the constituents are combined; in diseased bone they seem rather to be mixed. The animal constituents are likewise more fatty and less nitrogenized than in normal bone, the fat is more free. In the mineral constituents the proportion of the carbonate of lime to the phosphate is much diminished."

The *prognosis* in these cases is always bad, although the possibility of a cure should not be doubted. Trousseau relates cases in which a good result was obtained under the combined influence of rest, warmth, good food, and cod-liver oil; the deformity, of course, remaining. Lime salts ought not to be given in these cases, as they cannot be retained, and to give them, adds Durham, is only to throw additional work upon the excreting organs.

Rickets is an affection of early childhood, and, by Sir W. Jenner, is said to be the commonest of the diathetic affections among the London poor. It is, however, found in the families of the higher classes, and it is essentially due to some mal-nutrition of the body, connected probably with bad feeding and the use of farinaceous in lieu of animal food, the bones during their period of growth expanding at their epiphysial ends and bending in their shafts, and being very prone to incomplete or green-stick fracture. "Displacement and obliquity of the epiphyses may ensue from softness and flexibility of the layer of bone uniting it to the diaphysis, as is seen more especially in the ribs; but a slighter degree of epiphysial obliquity is noticed in many of the joints of the long bones, such as the knee or ankle; the weight of the body is thus thrown unequally, so that one set of ligaments has to bear more traction than another. These ligaments then yield, and the joints become loose, so that rachitic knock-knee (*genu valgum*) or bow-legs (*genu varum*) is formed."

"From sustaining the weight of the body the femur bends forwards, the tibia usually forwards and either inwards or outwards, the greatest amount of yielding being where the bone is thinnest and weakest. In many cases we find the os femoris bent forwards, with anterior and outward curvature of the tibia, knock-knee and flat-foot being coexistent in the same individual. Just so far as the rachitic condition extends so may we look for abnormities of form; thus, the *pelvis* may acquire some of those well-known contractions of its outlet which are matters of such grievous moment to women at the period of parturition," the pelvis either retaining in adult life the small size and imperfect development of infancy, or becoming narrowed as to its cavity in one or other of its diameters.

The chest also undergoes allied changes, and Mr. Shaw has well pointed out ('Holmes's System,' vol. iv) how "pigeon breast" is one of the effects of the disease; atmospheric pressure bending in the bones that have lost their elasticity and become softened, and causing a projection of the sternum and lateral flattening of the chest.

In the spine, a general curving of the whole column is the more usual deformity; "*lordosis*," or anterior projection of the lumbar vertebræ, as a compensating curve, being found when pelvic obliquity is present.

In all cases of rickets, Humphry has shown ('Med.-Chir. Trans.,' 1862), that deficiency of growth coexists with deformity, the lower limbs more than the upper indicating this in their proximal segment. In severe cases, all the bones are more or less deformed, the *cranium*—often large—presenting a quadrilateral aspect, with sutures widely open till a late period of life, or even subsequently re-opening, the bone either remaining thin or subsequently thickening. The periosteum in these cases is also usually thickened both in flat as well as in the long bones.

The general symptoms of rickets are those of debility, muscular and general weakness of the whole frame gradually passing into that of rickets; dentition is retarded, and teeth decay or drop out. Sir W. Jenner lays great stress upon profuse perspiration of the head during the night, a tendency to kick off bedclothes, fetid stools, and general tenderness of surface, as constant symptoms of the early stage.

Tomes and De Morgan inform us that a rickety bone has the structural arrangement of normal bone without the earthy salts. Jenner ('Med. Times,' 1860), however, describes an enlargement of the lacunæ generally, the effusion of a red pulpy substance in the cancellous tissue, and a thickening of the periosteum; while Gee ('St. Bart. Rep.,' 1868), Dickinson ('Med.-Chir. Trans.,' 1852), and others, have pointed out how the viscera undergo some "albuminoid" changes, unlike the waxy or lardaceous disease.

Rickets is a curable affection, that is, if taken before it has far advanced and it is remarkable to what an extent the deformities are remediable under natural processes, the curved or bent shafts of bone recovering their natural shape on taking off downward pressure and improving the general powers of the child. In more severe cases where the curvature cannot be remedied, the bone consolidates and becomes strengthened by buttresses of bone along the concavity, and, although the stature may be diminished and the limbs deformed, the general powers of the patient may be restored and a sound recovery take place.

TREATMENT.—The *medical* treatment of rickets should be conducted on reasonable principles—fresh air and abundance of it, simple nutritious food such as may suit the conditions of the digestive organs being essentials; milk and beef tea for young children should be mostly relied upon, and meat in moderation for the older. Cod-liver oil, iron, and quinine, are also very valuable drugs. The bowels should be carefully attended to, while all violent purgatives ought to be avoided.

The *surgical* treatment in the early stages is the prevention of deformity, and in the later the remedying of it. By way of prevention, the child should be restrained from any prolonged standing or sitting position, the horizontal posture should be observed as far as possible, some little exercise being allowed and then rest, the two alternating according to the powers of the patient and the necessities of the case. As the general health and powers improve, more liberty may be allowed. In spinal cases these observations are more especially binding, and in them movable couches and spinal chairs are of great service.

Where modern deformity exists, more particularly in the lower extremities, it is often interesting to observe how, by the above means, the bones recover their normal shape, children "growing out" of their deformity as their health improves, as long as the surgeon takes care it is not increased by neglect.

In still worse examples, and where exercise is essential and intermittent rest will not be observed, splints and instruments may be bound to the legs. Two long side splints reaching to the ground, carefully bound together and removed at night, are as good as any, or an iron splint with joints at the knee and ankle. Some surgeons prefer an outer splint for knock knee, and an inner one for bow legs.

When the curvature of the shafts of the leg bones is very great or acute, Mr. H. Marsh has adopted the plan of forcibly straightening the bones when the patients are under chloroform. He thinks little of the risk of breaking the bone, knowing how rickety bones unite ('St. Barth. Rep.,' for 1870). He believes the plan more adapted for acute than chronic cases. In extreme cases, a wedge of bone may be removed from the shaft. I did this in 1863 on the leg of a child between four and five years of age, and Mr. Little has more recently performed the same operation with advantage. It should only be done in extreme instances of deformity, and when no hope of improvement by other means can be entertained.

OSTEITIS DEFORMANS.

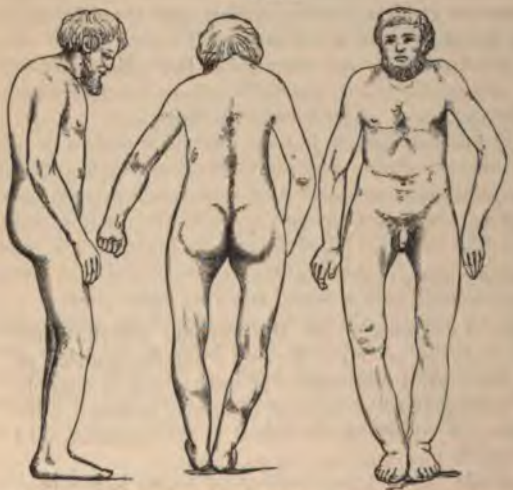
This name has been given by Sir James Paget to a remarkable disease which he has described in an able paper published in vol. lx of the 'Trans. of the Royal Medical and Chirurgical Society,' 1877. I have recorded in the 'Guy's Hospital Reports' for 1877 a good example of it.

It begins, writes Paget, in middle age or later, is very slow in progress, may continue for many years without influence on the general health, and gives no other trouble than that which is due to the changes of shape, size, and direction of the diseased bones. Even when the skull is hugely thickened, and all its bones exceedingly altered in structure, the mind remains unaffected.

The disease affects most frequently the long bones of the lower extremities and the skull, and is usually symmetrical. The bones enlarge and soften, and those bearing weight yield and become unnaturally curved and misshapen, suggesting the proposed name "osteitis deformans."

The spine, whether by yielding to the weight of the overgrown skull or by change in its own structures, may sink and seem to shorten, with greatly increased dorsal and lumbar curves; the pelvis may become wide, and the necks of the femora become nearly horizontal. But the limbs, however misshapen, remain strong and fit to support the trunk. (*Vide* Fig. 602.)

Fig. 602.



Drawing taken from Author's case, 'Guy's Rep.,' 1877.

In its earlier periods, and sometimes through all its course, the disease is attended with pains in the affected bones, pains widely various in severity and variously described as rheumatic, gouty, or neuralgic, not especially nocturnal or periodical. It is unattended with fever. No characteristic conditions of urine or feces have been found in it, nor is it associated with any constitutional disease, unless it be cancer. Three out of the four cases recorded have ended in connection with this affection.

The bones examined after death show the consequences of an inflammation affecting, in the skull, the whole thickness; in the long bones chiefly the compact structure of their walls, and not only the walls of their shafts, but in a very characteristic manner those of their articular surfaces.

"The changes of structure produced in the earliest periods of the disease have not yet been observed; but it may be believed that they are inflammatory, for the softening is associated with enlargement, with excessive production of imperfectly developed structures, and with increased blood-supply.

"Whether inflammation, in any degree, continues to the last, or whether, after many years of progress, any reparative changes ensue, after the manner of a so-called consecutive hardening, is uncertain."

The disease does not apparently have any shortening influence on life, for in Sir J. Paget's case it had existed for twenty years, and in my own the man is now sixty-three, and in robust health, the symptoms having shown themselves about seven years.

I also, in May, 1877, saw a second example of this affection in the person of a married lady, æt. 54, who, although in the enjoyment of excellent health, was quite unable to walk without crutches, on account of the weight and weakness of her legs. The disease had been gradually coming on for six years, and the pains in the thighs had given her great trouble. When I saw her she came into my room on crutches and sat down with the arched back so peculiar to this affection, her thigh bones were enormously thickened and bent, the necks of the femora were horizontal, as proved by the test line of the ilio-femoral triangle (Fig. 506), and the knees were far apart from the bowing of the legs. The bones of the upper extremity were also clearly enlarged. I could not make out that the cranial bones were involved. The lady informed me that she was at least an inch shorter this year than she was last, the changes in the necks of the femora would, however, account for this fact.

She had had two sisters, one died from cancer of the breast, while the second was an imbecile and had died in an asylum.

The case well supports the observations that have been made.

Sir J. Paget regards the disease as inflammatory, Dr. Goodhart brings forward another hypothesis. He does not think the term inflammatory can be considered as properly descriptive of this disease, partly because to give "inflammation" so wide a meaning as would embrace a general hypertrophy of all the bones, as one of its results would be to deprive the term of all significance; and also because it is still less applicable to other diseases allied to the one in question.

Dr. Goodhart considers that hyperostosis is essentially a new growth, or as he expresses it, a generalized bone tumor, and adduces in support of this view:—1st. The clinical history of the disease; its coexistence with otherwise good health; the absence of pain, its intractability under treatment; its frequent association towards its close with some other form of malignant tumor. 2dly. Its peculiar parallelism with molluscum fibrosum and a form of elephantiasis, which is a corresponding disease in the subcutaneous or fibro-cellular connective-tissue, to this in bone connective tissue. There is certainly a good deal to be said in favor of this view, and though Sir James Paget does not see his way to adopting it as the more probable, I am, on a review of the whole subject, and unfettered by any partiality for a theory of my own, inclined to think with my colleague.

No treatment seems to have the slightest influence on the progress of this affection.

CHAPTER XXXIV.

ON GUNSHOT INJURIES.

"Gunshot Injuries," writes Professor Longmore, "are the injuries which result from the action of missiles set in motion by a force which is derived from the ignition of explosive compounds. They comprehend every kind and degree of hurt which is capable of being produced on the human frame by the mechanical impulse of obtuse bodies." He informs us, moreover, that in every 100 casualties there are 20 killed to 80 wounded, and that of the wounded one-third of the cases are severe and two-thirds slight.

The wounds vary much in their character and nature—one caused by a rifle ball differing from that by a cannon ball or shell; and the *direct* effect of a missile upon a part differs from that produced *indirectly* by the scattering of stones or any other hard substance caused by cannon shot or shell. *Gunshot contusions* of tissues, although apparently trivial, are, as in civil life, often associated with severe deep-seated injuries; and superficial wounds, apparently unimportant, are often attended with or followed by serious accidents. Gunshot wounds are always of the *contused* class, those of civil life, however severe, are rarely, if ever, attended with that complete attrition and displacement, and even total removal of substance, which are so constantly characteristic of wounds produced by gunshots, particularly in those of recent times. Gunshot wounds, moreover, are also prone to be complicated by the introduction into the wound of some foreign body, such as some portion of the soldier's dress pressed into the wound, or some part of the wadding, shot, or shell itself.

It should also be known that "substances of very low degrees of density, such as plugs of tallow, light wood, cork, wads of paper, and others, will serve to inflict penetrating wounds in the softer structures of the body, having all the characters of wounds inflicted by denser projectiles, if sufficient velocity be impressed upon them. But the necessary force to accomplish this result can only be executed within very limited distances." (Longmore.)

"The external distinguishing signs of penetrating gunshot wounds are generally manifest enough. The general dimensions of the opening made by the shot sufficiently show whether it has been made by a small-arm bullet, a large grape shot, or a still larger gunshot; its shape, whether it has been made by a round projectile, by a fragment of a shell, or an irregular splinter of some secondary missile, while the aspect and condition of the lips of the wound and of the structures immediately surrounding it, sufficiently mark it as not being one inflicted by a stabbing or cutting instrument."

Gunshot wounds differ considerably in appearance, these differences depending upon the forms of the missiles causing the injury, and their speed, as well as the part of the body struck, and the position of the patient relative to the projectile at the time of injury. When part of the body is carried away by a gunshot at *full speed*, the surface of separation will present a level yet contused and almost pulpified aspect. When the *speed is less rapid*, the soft parts where the separation has taken place will be more lacerated and the bone comminuted; and when the *speed is spent*, or oblique in direction, the injured parts will either be crushed more or less deeply, or with little or no evidence of external injury the deeper parts may be irreparably disorganized.

Again, **bullets when at full speed** perforate or penetrate, but when at lessened speed they crush and lacerate. When a gun is discharged *near the body*, the parts around the wound of entrance will be blackened, and burned, while the wound of entrance appears as if punched out. When the discharge of the musket takes place *a few inches from the body*, the injured tissues will be more or less scorched, blackened, and studded with grains of unexploded powder, and the wound of entrance large, ragged, and excavated.

Wounds from bullets not at full speed, and fired at a distance of two or three hundred yards, will present an opening the size of the projectile, or possibly smaller, circular in shape, with serrated (inverted), undermined, puckered, and flabby edges; at times, however, a flap of skin is found at the opening.

The margin of the opening will appear as if contused, the evidences of bruising fading away into the surrounding tissues.

When the *speed of the bullet is much* diminished, no skin may be carried away—the diminished speed of the missile simply stretching and tearing asunder the tissues to allow of entrance.

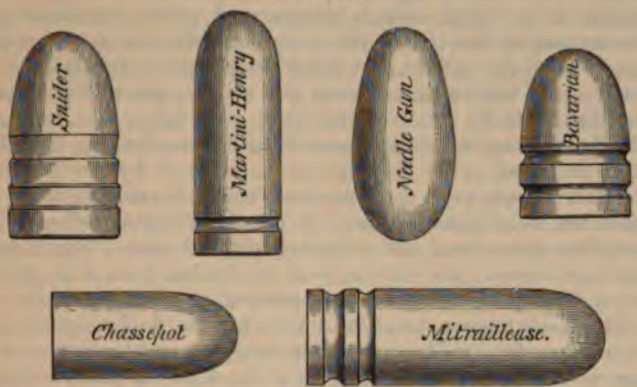
When wadding or other foreign substance has been carried into the wound of entrance, this will of necessity be more lacerated, and appear larger than it would otherwise be; and the same conditions may be found to exist when a ball enters the body where bone is only covered with thin integument.

In modern warfare where the rifle bullets are of a cylindro-conoidal form (Fig. 603), soft parts are more readily penetrated and bones more generally split or splintered than was found, of old, from the impact of round balls. In the late Franco-German war these points were generally observed, and although the Prussian and Bavarian balls were said to be larger than those of the French, the wounds produced by all were very much alike; if anything, however, the wound from the needle-gun produced the wider tract and larger opening.

Indeed, in the "seton wounds," or wounds penetrating the soft parts alone, of all these balls it was often difficult to make out the wound of entrance from the wound of exit.

When they traversed the soft parts alone, they often ran so cleanly through them, that only slight suppuration followed and repair was rapid; these modern balls causing less severe lesions of the soft parts than the old spherical balls. Billroth asserts that wounds with split-like exits were remarkable for the amount of suppuration that followed. When bones were struck, no matter what the form of ball, the injury was alike; there was comminution, vertical splintering, and at times almost pulverizations. Indeed, in civil life there is nothing like the splintering and comminution of bones seen in wounds from rifle bullets.

FIG. 603.



English and foreign bullets, now employed, of natural size.

The amount of alteration in form which the projectiles assume after striking a bone is very remarkable—some being completely flattened, others strangely contorted, while many are split.

Dr. Knester, of the Augusta Hospital, Berlin, however, has proved by experiment (1874) that the amount of injury the bones and soft parts sustain in a gunshot wound depends much upon the softness or hardness of the bullet—a hard one going through a part and leaving a "seton wound," where a soft one would produce frightful destruction of tissue. He explains this fact by the lead of the softer bullets becoming heated by collision with bone and broken up (not melted). The Martini-Henry bullet is a hard one and made of twelve parts hard lead, and one tin. The Chassepôt and the others are all made of soft lead, and consequently break up and flatten out against bone, thereby causing large apertures of exit and great laceration of tissue.

When the head of a bone is struck it is probably comminuted. When bones are not broken but only bruised, acute periostitis and endostitis are very common, the concussion of the bone being generally so severe as to excite acute action.

With the rifle-ball the course is more frequently direct than with that from the old smooth-bored musket. Tortuous courses are even now met with, but less frequently, the weight of the ball and the extreme velocity with which it flies producing a more direct route. It penetrates the soft tissues in a direct line, and when it strikes bone either runs through or splinters it, entering it like a wedge. It will often appear, writes Longmore, that the track of a bullet, even at full speed, is widely removed from a straight line. But it usually is not difficult to reconcile the apparent irregularity in the course the projectile has taken if the many varied positions in which the body and its parts are liable to be placed are called to mind, and if, when making the examination, the surgeon takes care to place the patient in a similar position to that he was in when struck.

The injury imparted to soft parts by what are called spent balls or *ricochet* shots is the most destructive, and large projectiles "*rolling over*" the surface of a part, or moving at low rates of speed, possess a force which will crush all parts with which they happen to come in contact, even extremities, and rupturing internal organs in a way peculiar to themselves.

A conical rifle ball, when partially spent, may lodge in a part, either in a bone or some soft tissue. It may take some unusual path and lodge where the surgeon cannot find it, or remove it; and under these circumstances, it may rest, become encysted, and give but little trouble. But, on the other hand, it may set up a chronic inflammatory action in the part and give rise to local suppuration. Bullets, however, rarely lodge in the soft parts without giving rise to suppuration, although in bones they may do so. Such cases should not, however, induce the surgeon to leave them alone when they can be removed; they should always be extracted if possible, unless they have penetrated any of the great cavities of the body. Billroth speaks very strongly on this point. In all blind wound tracks of the extremities, the finger should be passed into the wound and the foreign body looked for, the external wound being enlarged when needed for this purpose; and in *non-penetrating* wounds of the head, chest, abdomen, and pelvis, the same practice may be observed. The removal of the ball as the cause of irritation has not only a beneficial influence on the body of the patient, but it has an equally beneficial influence upon the mind; for as long as the ball remains lost in the tissues, the soldier naturally regards it as a serious impediment to his recovery, and there is no effect equal to that caused by its removal. Billroth has found much assistance from Nélaton's sound in doubtful cases, but, as a rule, he says that projectiles that cannot be reached by the fingers can rarely be extracted, the bullet forceps, even the American, being of small value.

When a part of the body is carried away by a *cannon ball at full speed*, the stump will present a level surface of contused and almost pulpified tissues. The muscles and integument will not have retracted; the extremity of the broken bone will probably stand out, small fragments of bone being scattered over the surface of the wound.

When the same result follows the contact of a *cannon ball, the force of which is partially expended*, there will be evidence of more dragging and laceration of the soft parts, more irregularity of the wound, more hanging of the muscles, greater comminution of the bone, and greater injury to the soft parts above the seat of separation, and probably greater splintering of the bone upwards.

When the force of the *cannon ball is still less or spent*, there may be no separation of impaired parts, but a general contusion, crushing, or disorganization. In some cases where the force is oblique, there may be no external evidence of injury, this want of external evidence being too commonly associated with broken bones or severe internal laceration of viscera or soft parts. Such cases were formerly set down as due to "wind contusions," or, the "brush of a shot," but are now believed to be caused by contusions of nearly spent cannon balls, or glancing blows from some projectile.

Shell wounds, as a rule, produce severe laceration of soft parts, and though they may penetrate tissues, yet they very rarely pass through them.

The wounds produced by rifle-balls at full speed at the point of *entrance* are often small, circular, clean cut, and inverted edges; but at the point of exit large, irregular, and with everted edges.

As the distance from the weapon increases and the velocity of the ball diminishes, so the wound of entrance becomes less circular and regular, larger and more contused; the wound "sometimes consisting of three triangular flaps, which on being lifted up can be made to meet at their apices in the centre of the opening."—*Longmore.*

When the ball has passed through the part the wound of exit will probably be larger than the projectile, more irregular, torn, and everted than that of entrance, the subcutaneous fat projecting. At times, however, with the cylindro-conoidal bullet discharged at full speed, there is little difference between the two wounds. In the patient's clothing, when the wound of entrance is punctured, that of exit will be lacerated.

The *pain* caused by a gunshot wound depends upon the parts that are injured. In a general way it is not severe, and when so, is evanescent; writers tell us, that it is often described like the sudden stroke of a cane, or the shock of a heavy blow. Sometimes soldiers are unaware of their wounds. When the trunks of nerves are pushed aside and injured, intense pain may be felt, but not locally. Longmore relates the case of an officer, who, from his sensations, thought his arm was broken, but on examination no such injury existed, a ball had passed from right to left through his neck, which probably injured some of the cervical or brachial plexus of nerves, thereby giving rise to his error. More pain is occasionally felt at the wound of exit of a bullet than that of entrance.

Shock.—"When a large bone is suddenly shattered, a cavity penetrated, an important viscus wounded, or a limb carried away by a round shot, the most prominent symptom is the general perturbation and alarm which in most cases instantaneously supervene on the injury. This is generally described as the 'shock' of the gunshot wound. The patient trembles and totters, is pale, complains of being faint, perhaps vomits. His features express extreme anxiety and distress. This emotion is in great measure instinctive, and seems to be sympathy of the whole frame with the part subjected to serious injury, expressed through the nervous system. This shock is more or less persistent, according to circumstances. Examples seem to show that it may occasionally be overpowered altogether, even in most severe injuries, by moral and nervous action of another kind, by a state of mental tension, but this can rarely happen when the injury is a vital one. Panic may lead to similar symptoms of shock, although the wound is of a less serious nature. A soldier, having his thoughts carried away from himself, his whole frame stimulated to the utmost height of excitement by the continued scenes and circumstances of the fight, when he feels himself wounded is suddenly recalled to a sense of personal danger; and if he be seized with doubt whether his wound is mortal, depression as low as his excitement was high may immediately follow. This depression will vary in degree, according to individual character and intelligence, state of health and other personal peculiarities. For while, on the one hand, in every action numerous examples occur of men walking to the field hospital for assistance almost unsupported after the loss of an arm or other such severe injury; on the other, men whose wounds are slight in proportion, are quite overcome, and require to be carried."

"As a general rule, however, the graver the injury, the greater and more persistent is the amount of 'shock.' A rifle bullet which splits up a long bone into many longitudinal fragments inflicts a very much more serious injury than the ordinary fracture effected by the ball from a smooth-bore musket, and the constitutional shock bears like proportion. When a portion of one or both of the lower extremities is carried away by a cannon ball, the higher towards the trunk the injury is inflicted the greater the shock, independent of the loss of blood. When a ball has entered the body, though its course be not otherwise indicated, the continuance of shock is a sufficient evidence that some organ essential to life has been implicated in the injury."—*Longmore.*

Hemorrhage.—The amount of hemorrhage attending a gunshot wound varies according to the size and situation of the wounded vessels. When large vessels are involved, death is rapid, and such cases do not come under the notice of the army surgeon.

In the cases that come into the surgeon's hands in a general way there has been an attack of hemorrhage directly after the injury, but little more; possibly some oozing, but rarely much, may exist.

When a limb is shot off, there is rarely more bleeding than when it has been torn off by machinery as seen in civil life. Large vessels, when torn or twisted, seldom bleed. In these cases the plugged pulsating extremity of the lacerated artery will generally be found projecting from the wound.

In the wound caused by *rifle-balls*, vessels escape in a marvellous manner, the great resiliency of large vessels and the freedom with which they slip away under pressure from their loose cellular connections, allowing a ball to pass along or across their course without wounding them. At times the vessels may be so contused as to become obstructed and obliterated (*vide* Prep. at Netley). Nevetheless, a rifle-ball occasionally may directly divide a large artery and cause instantaneous death. In the American war, among the cases of primary gunshot lesions of the arteries that came under treatment, it was found that in most, only a portion of the calibre of the vessel had been carried away, and that retraction had thus been prevented.

Secondary hemorrhage is common in gunshot wounds, and is due probably, as a rule, to the reopening of a wound in a vessel temporarily closed, or to the sloughing of some part of its walls that had been injured. In the *former* case, the new tissue that had stopped for a time the flow of blood, gives way under some sudden movement or local mechanical force such as some foreign body in the wound; or breaks down during the suppurative or sloughing process. In the *latter*, the injured coats of the artery are cast off, having been destroyed by some contusion or other violence. In either case the thrombus or clot in the vessel is not sufficiently well formed or organized to resist the force of the blood current from behind. When such a clot organizes, there will, of course, be no bleeding. "The great frequency of secondary hemorrhage has for its chief causes the absence or faultiness of sanitary conditions, and the debility of the patient, due to privation of nourishing food, and to exposure. The means calculated to remove or anticipate such evils will, if applied, be of more value than is the ligature in coping with secondary bleeding after gunshot injury."—*Mac Cormac.*

With respect to the treatment of secondary hemorrhage after gunshot wounds it is in principle, similar to that which the civil surgeon follows. Styptics where large vessels are concerned are worse than useless. Pressure is only applicable for temporary, but not curative purposes, and thus the surgeon is driven to cut down upon the wounded artery to tie or twist both ends, or, to apply the same practice to the vessel in its continuity leading to the seat of bleeding when the former operation is too difficult or dangerous. Billroth advocates dealing with the main trunk of the bleeding vessel at an early period of the hemorrhage, and not wasting time by delay. He says that out of twenty-three cases in which he applied a ligature to large arteries for hemorrhage, death took place in seven from bleeding on the separation of the ligature, when no clot was found in the vessel; in twelve from hemorrhage and pyæmia, of which no examination was made, and seven alone recovered.

In the late Continental war Stromeyer and Mac Cormac maintain that the result of such operations was uniformly unfavorable. Out of twelve cases which Stromeyer saw, only two recovered. "I think," he says, "we must decide to amputate oftener in cases of secondary hemorrhage."

Possibly a better result might have followed torsion of the arteries, for, after such a practice, when bleeding has been arrested, there is nothing to set up fresh mischief in the artery, no foreign body like the ordinary ligature to excite any ulcerative or disorganizing process through which hemorrhage may take place; the thrombus that forms in the vessels after torsion, being allowed to go on undisturbed, to organize and to become incorporated with the incurved middle arterial coat as one firm organized fibrinous mass. The catgut ligature, however, may possibly be of use in these cases.

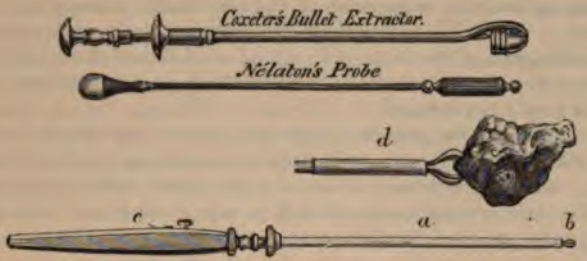
Treatment.—In the front of the battle-field little more can be done in the way of treatment of gunshot wounds than the application of some provisional dressing; some pressure or tourniquet to arrest hemorrhage when the vessel cannot be at once secured; some splint or other available support to prevent extra injury being inflicted by movement to the field hospital. Before examining a wound, the cloths that cover it should be carefully looked to, and more particularly the garment next the skin, for "it occasionally happens that a bullet will have sufficient force to penetrate the body to a limited distance, at the same time carrying a portion of the wounded man's shirt before it, while, owing to the yielding nature of the material it fails to tear a piece out of it. The bullet will then lie, as it were, at the bottom of a pouch of the shirt like the finger in a glove; and when the shirt is taken out the bullet will be brought away with it." Longmore, in his recent work on "gunshot injuries," relates several instances of the kind.

At the field hospital the wound should be thoroughly and carefully examined, and to do so, the patient should be placed, when practicable, as near as possible in the position he occupied when he received it. All foreign bodies must be taken away, bleeding vessels ought to be ligatured or twisted; and, when necessary, the wound should be enlarged for the purpose. No make-shift of pressure or other temporizing means should be employed. When great collapse or "shock" exists some gentle stimulant may be given. The true condition of parts is to be made out at once, and the plan of treatment laid down, soft parts being adjusted, operative interference decided upon when necessary, and right appliances employed.

By far the best instrument to explore a wound is the finger, and for this purpose the external opening through the fascia may always be enlarged. "Probes should seldom or never be used; the finger is by far the best instrument if the wound will admit it" (John Hunter, MS. lect., 1787). "No artificial instrument can give the same amount of information or afford information so precise with regard to the lodgment of foreign bodies and their nature as the surgeon's finger can give. The surgeon should not withdraw the finger until the course the projectile has taken, the injury it has done, the complications of the wound, such as the presence of foreign bodies, and, in such a case, their kind and situation, have been decided by him; the exploration will then be completed by one operation, and a second insertion of the finger for the purpose, which is always irritating to a patient will be avoided." The knowledge gained, moreover, will be definite and of special utility in determining the proceedings to be afterwards adopted. The exploration is often assisted by pressing the soft parts, especially if the wound be in one of the extremities, from an opposite direction towards the finger end." Sometimes, when a lodged ball cannot otherwise be discovered, it may be found by passing the flat palm of the hand down the limb. "Sometimes," writes Longmore, "it may be detected simply by relaxing the muscular tissues, so as to give a loose and pendulous condition to the parts concerned, and then lightly tossing up the flesh at different points from below with the tips of the fingers." When the finger passes through an opening in fascia or a deep aponeurosis, the track will feel constricted, when through muscles and connective tissue expanded.

When sufficient information cannot be acquired through the finger either from the length of the wound or its tortuosities, probes must be used. Nélaton's (Fig. 604), with a small ball of porcelain at the end, is good, and so also Sayre's snake-jointed probe, with a like end. Longmore prefers a long silver probe, which can be bent to any angle, but speaks highly of Dr. Lecomte's stylet-pince. It responds as an indicator with even more distinctness than the Nélaton probe in all cases in which the test would be of service, while it answers for a variety of other cases in which Nélaton's probe would give no indication at all. By it small particles of the substance embedded in the tissues can be extracted for examination, and many foreign substances altogether removed.

Fig. 604.



Lecompte's Stylet-pince.
a. Cannula moving over (b) cleft steel rod with closed curettes at end, fixed in handle; (c) the gliding of the cannula determining the opening or closing of the curettes; (d) curettes open grasping bullet.

In gunshot fractures of the shafts of bones which are to be treated conservatively, Stromeyer advises that no probing ought to be performed, and in doubtful or in operation cases, it ought only to be done just before the operation or under chloroform.

Electric indicators have been employed, and some are most ingenious and possibly valuable, but they are not portable. The appliance of Mr. De Wilde, in which contact with the metal of a ball is notified by the sound of a bell is particularly taking, and a very useful apparatus has also been made by Messrs. Krohne and Sesemann, of Duke Street, Manchester Square. Professor Longmore speaks highly of both, but prefers the latter. It is designed to ascertain with absolute certainty, if a substance lodged in the body, and admitting of being touched with the probe or grasped with the forceps, is a bullet, a fragment of a projectile, or other metallic substance. The probe is elastic, and follows the track of any projectile more readily than a stiff probe. Two sharp needles are concealed in it, which, when a hard body is felt, are pushed forwards one after the other. This is done by pressing the small buttons on the handles towards the probe. As soon as the two points touch the foreign substance, if it be metal, the electric current passes through the instrument, a fact immediately indicated by the hand on the dial. The hand moves actively either towards the right or left side. The forceps possess this principal advantage that they can be also used as a probe, thereby dispensing in many cases with the use of the elastic probe altogether. The extremities are furnished with Assalini's points, with which particles of clothing can be removed, if such should be before the projectile. If a foreign body is touched with the forceps it should be gently grasped between both blades. If it be a bullet or any piece of metallic projectile, the electric current passes through it, and the hand on the dial moves again actively, as described above. It is, of course, necessary to fix the connecting wires of the instrument into the brass heads on each side of the dial. In the drawer below the dial there is a small battery charged with sulphate of mercury. If the charge has become too dry and weak it should be moistened with a few drops of water, and a few pinches of sulphate of mercury should be added. It is to be observed that the zinc plate touches the platinum points in the trough.

In exceptional and chronic cases where time has been allowed to pass, these instruments are of greater use than in primary cases.

It need hardly be reasserted that when a ball has penetrated any of the cavities of the body such as the head, chest, or abdomen, it is not to be sought for on any account.

When a foreign body has been detected it should be removed; at least this is the rule. Coxeter's extractor, composed of a scoop for holding and a pin for fixing the bullet has been highly praised (Fig. 604). Instruments with blades cannot be recommended as they necessitate the dilatation of the wound.

Mac Cormac writes, "The bullet forceps I preferred was one with claw points, at a right angle with the handle, and slightly overlapping, so as to admit of easy ingress. When these catch the bullet they rarely let it slip. The extraction of bullets, however, requires skill and patience; much injury may be inflicted on surrounding parts by the incautious use of the bullet forceps."

When, from the smallness of the wound of entrance, force is required, it is better to enlarge than to stretch the wound. When the foreign body rests beneath the skin, an opening through it may be made.

When balls lodge in bone, they should be removed as from soft parts; when they can be raised from their bed by an elevator, such an instrument should be employed. When forceps are wanted for extraction Luer's "sharp-pointed bullet forceps, which bite into and secure a most firm grasp of the object, will best accomplish the extraction." To aid extraction the gouging away of some part of the bone may be necessary.

As a rule, however, with rifle balls, the bone is splintered; and, under these circumstances, when the epiphysis of the bone is involved, excision of the joint is called for when the joints of the upper extremity or the head of the femur is involved, and amputation when the knee and ankle are injured.

After the removal of all foreign bodies from the wound, and when the parts have been cleansed, they should be carefully adjusted, placed at rest in an easy position, and protected by wet or dry lint; union by adhesion is out of all question, and that by granulation alone can take place. To hermetically seal a wound is not a practice to be generally recommended. Some gentle support by means of a bandage not only gives comfort, but is beneficial.

When suppuration has taken place, the greatest care is needed to prevent burrowing. As soon as abscesses form they should be lanced, and that freely. When the wounds of entrance and exit are opened, the intervening sinus may be syringed with advantage, some medicated lotion such as iodine water, Condy's solution, or carbolic acid, one part to a hundred, being used.

Under all circumstances, thorough cleanliness should be observed, good food with tonics and sedatives given; fresh air being allowed to circulate freely around the beds. Stimulants should be administered with great caution, enough only being allowed to assist the digestion of solid food.

Gunshot wounds of soft parts usually suppurate about the third or fourth day, sloughs mostly separate about the tenth or fourteenth; and recovery takes place in five or six weeks, the wound of exit, as a rule, closing before that of entrance.

GUNSHOT WOUNDS OF THE HEAD.

A gunshot wound of the head received from a rifle ball at full speed produces a *diffused* injury to the skull and its contents; when caused by a spent ball or by a fragment of shell, the injury may be *localized*.

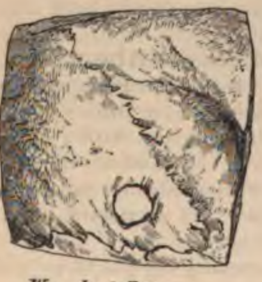
In the former cases the external evidence of injury bears no comparison with the real mischief the patient has sustained. In the latter the external evidence may be greater than the internal. Thus, the experience, says Professor Longmore, of the military surgeon, leads him always to hesitate in forming a prognosis, however limited a gunshot injury may appear to be at first observation.

Gunshot injuries are, moreover, specially prone to be followed by diffused meningitis, encephalitis, and the formation of deep-seated abscesses, this proneness to traumatic inflammation being clearly due to the injury the brain itself with its membranes has sustained; for in head injuries with which the civilian is familiar, this tendency to traumatic encephalitis bears a direct proportion to the injury of the cranial contents.

The opening made into the skull by a pistol ball when at full speed is clean and defined; that of exit larger and bevelled outwards. They are rarely complicated with fissures. When, however, the velocity of the ball is in a manner modified, there may be the same amount of "starring" at the wound as is seen by the civil surgeon.

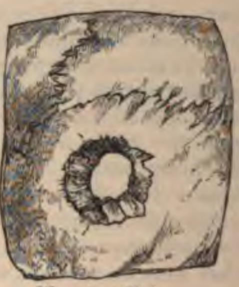
In military as in civil practice, the inner table of the skull is always fractured to a greater extent than the outer when the ball enters from without (*vide* Figs. 605–6, taken from Longmore's article in 'Holmes's System'); but the opposite condition exists when the ball passes through the skull on the opposite side of the

FIG. 605.



Wound of Entrance.

FIG. 606.



Wound of Exit.

cranium, the table of the skull corresponding to the point of exit of the ball suffering the most in both cases.

In military, as in civil practice the amount of external injury is no indication of the amount of internal mischief. A spent ball, a fragment of shell, a stone, may cause what appears to be only a contusion of the scalp, yet a fracture may coexist with such a contusion, and a considerable amount of intra-cranial mischief follow. "The amount of bruising obvious to sight and the degree of concussion may have seemed trifling, and yet the remote consequences may be serious enough."—*Longmore.*

Contused gunshot injuries without any external evidence of cranial mischief, are at times associated with such intra-cranial injury as to be followed by a speedy death. "Contusing and glancing shots," says Dr. Neudörfer, of Prague, in his 'Manual of Military Surgery,' will either occasion fissures, fractures, or depressions, or not interfere with the integrity of the skull at all, according to the velocity of the projectile and the elasticity and power of resistance of the bones."

Severe scalp wounds are generally caused by the impact of a projectile at an acute angle. Under such circumstances, the bone is often left intact, and little or no injury to the brain results.

At a less acute angle, the bone may be bruised, scratched, or furrowed, fissured, starred, or comminuted, and with these several conditions, more or less severe brain symptoms may be associated, the gravity of the symptoms depending on the severity of the concussion.

Concussion in military as in civil experience means either a temporary suspension of brain functions, a contusion or laceration of the brain structure, or a more or less severe extravasation of blood upon or into the brain itself. A severe contusion of the skull without fracture being quite capable of producing a fatal laceration of a sinus.

FIG. 607.

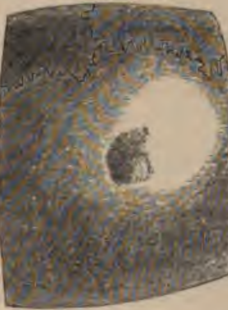
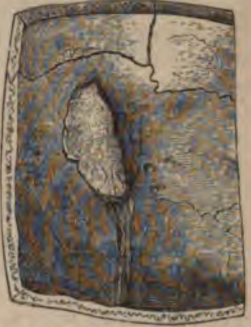


FIG. 608.



Circular No 6, Figs. 4 and 5, Washington.
Fig. 607.—Exterior view of the fore-mentioned specimen.
Fig. 608.—Fracture of the vitreous table of the frontal bone, without fracture of the external.

"A simple observation of the injury to the outer table, whether by sight or touch, will by no means necessarily lead to a knowledge of the amount of injury or change of position in the inner table."—*Longmore.* Indeed, it is quite possible for a piece of the inner table of the skull to be fractured and detached without any fracture of the external taking place. This is illustrated in Figs. 607–8, taken from the drawing of what is believed to be a unique specimen (2313, A. M. M.), in the United States Museum, published in Circular No. 6.

When the external table has been ploughed off by the projectile, care should be taken not to mistake such an injury for a fracture of both tables with depression.

In military, as in civil practice too, *fissured fractures* are mostly the result of blows by heavy projectiles, and fissures of the inner table without external evidence of the injury, occasionally occur.

Comminuted fractures in both military and civil experience are also chiefly local injuries, the force of the ball or blow expending itself on the injured spot.

Wounds complicated with fracture and depressed bone without lodgment of the projectile are most serious. Of seventy-six cases recorded after the Crimean campaign, fifty-five proved fatal, and of the twenty-one survivors twelve had to be invalided; "the severe concussion of the whole osseous sphere by the stroke of the projectile, the bruising and injury to the bony texture immediately surrounding the spot against which it has directly impinged, as well as the contusion of the external soft parts, so that the wound cannot close by the adhesive process, constitute very important differences between gunshot injuries on the one side and others."—*Longmore.*

Fractures of the cranium from gunshot wounds are not unfrequently *complicated with the retention of the projectile.* It may be that the ball has been flattened against the bone and lodged in the wound, or it may be that it has been split against the fractured cranium, one portion entering the skull and the other the integument. Under either circumstance, the segment that enters the skull may lodge either between the bone and the dura mater, or lacerate the membranes and enter the brain. Longmore gives a case in which there was a fissured fracture with slight depression, but no hole in the skull, where after death, half the rifle-bullet was found in the brain, the hole through which the half bullet had forced admittance having closed as soon as it had entered the skull. He gives, also, another precisely similar, which reflects great credit upon the surgeon, Dr. B. Howard, of the United States, in which, from the presence of a single hair protruding from within the broken bone, it was inferred that a solid substance had entered the skull. Trephining was performed, a distorted Minie ball removed, and recovery ensued.

Rifle bullets at the usual speed, however, in the majority of cases enter the cerebral mass, to make their exit, in some instances, at the opposite side of the skull, in others to rest beneath the opposite wall; at times, the ball takes a circuitous route. In all death follows, as a rule, no exception to this fact having been reported from the Crimean war.

TREATMENT.—To do nothing active when death appears imminent is a duty the student has to learn, but in the primary treatment of head injuries in the stage of collapse, in military as in civil practice, there is no more stringent rule than to abstain from interference, to wait and to watch. The patient should be relieved of all unnecessary dress; no tight belts or garment being allowed to interfere with the respiration. He should be placed in the horizontal position, and when moved from necessity, it should be done as gently as possible. When the extremities are cold extra covering may be applied and artificial warmth when possible.

As the case develops, its surgical treatment ought to be conducted on precisely similar principles to those laid down in former chapters. Practice is to be established on the preventive principle, to ward off intra-cephalic inflammation; perfect quiet, cold applications to the head, and liquid food, being three essentials. Foreign bodies are to be searched after and removed with extreme caution. When they have entered the skull, and still more the brain, all search is forbidden; but when situated at the external orifice they should be taken away, and the sooner the better. If a ball be so impacted as to be immovable, the wound in the broken bone may be enlarged to favor its extraction, but no unnecessary interference with the cranium or its contents should be entertained. All foreign bodies in the integuments outside the skull ought to be taken away as soon as discovered.

The opinion of most surgeons is decidedly against the *operation of trephining* in gunshot wounds of the head. When the operation is entertained it should only be in compound fracture with depression attended with brain symptoms. The experience of the Crimean war, of our own as well as of French surgeons—of the Schleswig-Holstein and Franco-Prussian wars as recorded by Stromeyer—of the Indian war as told us by Dr. Williamson, is, without doubt, decidedly against this operation. In the Crimean campaign, the trephine was only successfully employed in four cases in our own army, and among the French, it was for the most part fatal.

The late American war, however, gives us a more favorable result, but the report itself states that "the data are not sufficiently complete to admit of fair comparative analysis," so judgment must be withheld.

In compound fracture, loose fragments may always be removed. In all penetrating wounds of the skull with lodgment of the projectile, operative interference is out of all question.

As a rule, writes Mac Cormac, "the largest proportion of good results will obtain amongst those cases where the amount of operative surgery has been at a minimum."

By way of summary, it may be remembered, that cerebral concussion, rupture of one of the cerebral sinuses, and fatal intra-cranial hemorrhage may take place from a gunshot projectile without any external marks of injury, and that a gunshot injury of the head, followed by a scalp wound, without any cerebral symptom, may be followed by inflammation of the bone and meningitis.

The vitreous or inner table of the skull may be fissured, depressed, and even detached, without *any fracture* of the external table. The drawings taken from Circular VI of the Washington War Department, illustrate the fact (Fig. 607–8), such accident being probably the result of a small projectile striking the cranium very obliquely. Fissure of the internal table may also coexist with a linear fissure of the external table.

A ball may gouge out a portion of the external table of the skull without injuring the cranial contents.

The part or the whole of a ball, may partially penetrate the skull and be retained, or not enter it, or pass through it; the wound of exit through the thickness of bone, or through the two sides being larger than the wound of entrance.

Penetrating and perforating fractures of the cranium terminate favorably in quite exceptional instances.

Hernia or fungus cerebri may take place after gunshot, as after other injuries, and recovery in these cases may occur, the experience of surgeons in the American war clearly showing that this result is more likely to take place without, than with compression or operative interference.

Trephining may only be undertaken with a fair prospect of success in local fractures with depression and brain symptoms; loose fragments of bone being always removed in all compound wounds.

Gunshot Wounds of the Chest.

These are returned as one in ten among the officers and one in seventeen amongst the men in the Crimean war, about 30 per cent. of these died; in the American war the mortality was 73 per cent.

Non-penetrating gunshot wounds generally recover, although they are slow in healing, on account of the natural movements of the ribs interrupting the process of repair. They are, moreover, apt to be followed by pleuritis, on account of the frequency of the ball taking a circuitous course beneath the skin round the walls of the chest. When the chest has been severely contused from a spent ball or a heavy fragment of shell, abscesses or even necrosis of the ribs are prone to follow the accident, and from the same character of accident where there is no fracture, the lungs may be injured, this result being likewise met with in young subjects in civil practice when the chest is squeezed. Professor Longmore states that "ecchymosis, or at least congestion of the lung itself, to a partial extent, in all probability follows every non-penetrating gunshot wound of the chest of much severity." The ribs may likewise be broken and driven in, as in the direct blows of civil life.

Penetrating gunshot wounds are generally fatal, scarcely more than one in ten surviving, while death generally results directly from hemorrhage, or from the consequences of secondary inflammation of the thoracic organs. The difficulties of diagnosis in these cases are as great as they are in civil practice, especially if the bullet be small and has entered obliquely near the scapula, or if the track of the bullet is covered by sound skin. "It is only," says Longmore, "by a combination of symptoms, rather than by the presence of any one or other symptom, that a lung wound can in many instances be diagnosed." Penetrating wounds with lodgment of the ball are more fatal than perforating wounds, and a fracture of the rib at the wound of entry renders a penetrating wound more dangerous. When the lung has been wounded by a penetrating shot, shock, collapse, escape of air, hemorrhage from the external wound and from the lung, hæmothorax and dyspnœa are characteristic symptoms. The *shock* is, however, frequently less in penetrating than in non-penetrating wounds when the latter are attended with general concussion. It is remarkable that a lung may at times be completely traversed by a ball, and beyond the hæmoptysis and dyspnœa of the first few days be followed by only the most trivial symptoms.

External bleeding in chest injuries is also said to be more commonly due to laceration of an intercostal or the internal mammary artery than to a wounded lung.

Internal bleeding is the chief cause of death, but the surgeon has no means at his disposal to make out the exact source of the hemorrhage. A gush of blood from the mouth indicates the opening of a large vessel, but in more chronic cases the sources of the bleeding may be pulmonary or parietal. "The situation of the wound of entrance, or the course the ball has taken, inferred from the relative positions of the wounds of entrance and exit, will greatly help to determine the probable site of the bleeding, and to some extent its probable degree of gravity. Internal bleeding from a wounded intercostal artery is very rare."

Gunshot wounds of the heart are always fatal, although not always immediately. In a case recorded in Circular No. III. of the War Department of Washington the patient survived fifty hours, the pistol ball having wounded the right auricle.

Treatment.—To arrest hemorrhage, to remove fragments of bone or foreign bodies, and to do nothing that can interfere with nature's reparative processes, are the three great principles of practice to be observed. They are, indeed, precisely similar to those the civil surgeon follows. In bleeding from an intercostal artery, the best plan is to plug the opening, at least so says Professor Longmore. This may be done in the following way: "A large piece of linen is laid upon that part of the chest in which the wound is placed, and the middle portion of this linen is pressed into the wound by the finger, so as to form a kind of pouch. This pouch is then distended by sponge or lint pushed into it until the pressure arrests the bleeding; on stretching out the corners of the cloth the pressure of the plug will be increased."

If the wound is not attended with hemorrhage it should be cleaned and lightly closed, the side being strapped up to restrain movement. Hermetically sealing gunshot wounds of the chest is reprehensible. The patient should be laid on the wounded side with the wound downwards, to allow of the escape of discharges.

In all other respects, the treatment of gunshot wounds is similar to that of others, and the remarks already made are applicable to them. Venesection is less commonly employed now than it was by the surgeons of the Peninsular war, and in the American war appears to have been abandoned. The dangers of inflammation of the contents of the chest are the chief source of the surgeon's anxiety, and his aim ought to be to prevent them if possible, and when present to check them. Hemorrhage should be treated by the application of cold, perfect rest, and the administration of opium. When empyema follows as a secondary result, a free outlet may be made for the accumulated fluid.

Gunshot Wounds of the Abdomen.

These are mostly penetrating, and non-penetrating wounds are often associated with some injury of the abdominal viscera. Longmore informs us that in the Crimean campaign, out of 115 non-penetrating wounds and contusions, 22 deaths occurred, these cases including those of injured viscera. When death follows a non-penetrating wound it is, as a rule, from sloughing of the abdominal walls.

Penetrating gunshot abdominal wounds are generally fatal, nine out of ten of the Crimean cases, French and English, having been so recorded. In the American campaign the mortality was 74 per cent. Shock is always very great, and collapse from hemorrhage the most striking symptom. This is, indeed, says Longmore, "sometimes the only symptom which will enable the surgeon to diagnose that the viscera are perforated. The mind remains clear, but the prostration, oppressive anxiety, and restlessness are intense. Should life be prolonged, signs of peritonitis will soon appear."

In musket-shot wounds, it is exceptional for any of the abdominal contents to escape from the opening; but when they do, the nature of the wounded viscus will be indicated. The swelling of the margins of the wound accounts for this fact.

Wounds of the *liver* are attended with a large mortality, and are always complicated. Shock, and hemorrhage are the usual immediate causes of death; but when life is prolonged, peritonitis. Longmore saw only one case of recovery in the Crimea; while Dr. Otis records 4 recoveries in America, out of 32 cases of this form of injury. In Circular No. III of the Washington War Department 4 cases of recovery out of 15 from this injury are recorded, and in one the gall-bladder was wounded. Wounds of the *spleen* are almost always fatal from hemorrhage; and are generally complicated with other injuries.

Gunshot wounds of the *stomach* are not always fatal. They are made out to exist when the contents of the organ escape externally, or when, from the extent of wound, the viscus can be seen. They are always associated with vomiting of blood. Hennen records two good cases of recovery which occurred at Waterloo, and the well-known American case of Alexis St. Martin, reported by Beaumont, is another. Dr. Peters, of the United States Army, has also reported a case that occurred in the American war. Guthrie and Cooper give nine or ten others.

When the wound is incised, it should be stitched up. Opium should be administered with nutrient enemata. Nothing should be given by the mouth for some days.

Gunshot wounds of the intestines are not necessarily fatal, although instances of recovery are rare. Wounds of the large are not so bad as wounds of the small intestine. Hemorrhage, and, if not, peritonitis, is the usual cause of death. Longmore relates one case in which recovery took place. Dr. Hamilton, of New York (1865), quotes eight cases of fecal fistula which terminated in recovery by natural processes, all having taken place in the late American war, and in the older writers many more might be found. Dr. Habershon has recorded a most interesting case of gunshot wound of the colon through the right loin, the patient dying four years subsequently from albuminuria ('Guy's Reports,' 1859).

TREATMENT.—Absolute quiet is the most essential point to be observed in these, as in all other cases of abdominal injuries. The recumbent position should be enforced and maintained under all circumstances. Opium and morphia should also be given in repeated doses, no drug having a better influence in peritoneal inflammation. Absolute cleanliness of the wound should also be observed, but there should be no strapping or closing of the orifice. Simple nutritious food may be allowed, and, as the case progresses, solids may be gradually taken.

Fecal fistulæ appear to have a tendency to close by themselves. In the American cases they gave, in general, but little trouble in their management (Circ. No. 6, S. G. O., 1865).

With regard to exploring the track of the wound, the surgeon should never forget, says Lidell ('American Quart.,' 1867), "that in the management of these cases, art, to be useful, must be the servant of nature, and must seek to do good by assisting her mistress in the efforts at repair, and not by the introduction of new and violent measures which are liable to aggravate the original injury." He believes that neither the finger nor any instrument should be used for exploratory purposes, except in special cases. Dr. Otis, however, in Circular No. III of the Washington War Department, issued in 1871, p. 87, says that "the mortality of these cases is so great as to furnish an additional argument in behalf of Legouest's proposition to incise the abdominal walls and explore the track of the projectile in certain penetrating wounds. Thus only can the patient exchange the probability of inevitable death for the possibility of recovery, either through the prevention of extravasation by enterorrhaphy, or the bringing of the wounded viscus into apposition with the abdominal walls. For one, I am free to assert that where there is evidence that internal hemorrhage or fecal extravasation is going on, what may be termed the 'ostrich plan' of giving opium and making the patient comfortable should be abandoned; and I believe that prejudices similar to those that ovariotomy has successfully overcome in the last quarter of a century will be dispelled by the results of exploratory incisions in gunshot wounds of the abdomen before many years have elapsed."

Gunshot wounds of the bladder do not appear to be so fatal as the cases of ruptured bladder met with in civil life. Lidell reports two such cases where a good recovery followed, the projectile in both having passed completely through the organ. Guthrie has related six, in all of which recovery took place. Mac Cormac records a case in which the ball passed through the rectum and bladder, the feces for a time passing through the posterior opening, and the urine through the anterior. Both wounds closed by natural processes in seventeen days. In all of these the urine escaped externally through the wound made by the projectile, and thus prevented fatal peritonitis from taking place. Such instances as these indicate the proper practice to be pursued in all cases of ruptured bladder, viz., cystotomy, as for lateral lithotomy. When foreign bodies have been carried into the bladder, they should be removed, as a ball may remain in the bladder and become the nucleus of a calculus. Guthrie, Hennen, Cheselden, and Garengeot have given such cases, and Ballingall has collected nineteen. In Circular No. III of the Washington War Department three cases are recorded in which calculi were removed which had formed on bullets; one where a stone had concreted upon an arrow-head, and one on necrosed bone.

Gunshot wounds of the face are serious, from the fact that they are so frequently followed by secondary hemorrhage; and, as the deep vessels are usually its source, the difficulties of controlling it are always great. When this complication does not destroy life, good recoveries take place, wounds of the face always healing kindly and with little scar. When there is much loss of tissue, some secondary plastic operation may be required, and many are the instances of success following this practice.

Gunshot wounds of the neck are serious according to the nature of the parts involved. When the large vessels and nerves are injured, a fatal result generally takes place; and when the larynx or trachea is implicated, the risks of suffocation are great not only from the direct result of the injury, but from secondary œdema; when this latter complication occurs, tracheotomy should at once be performed. Wounds of the neck are very liable to be followed by septicæmia.

Wounds involving *the vertebræ* are usually fatal, those cases alone recovering where the spinous or transverse processes are the parts injured.

Gunshot wounds of the extremities include flesh wounds and contusions, fractures which are rarely simple, and compound fractures, wounds of joints, and compound fractures into joints.

All these may be complicated with some injury to the vessels and nerves of the part, and the lodgment of foreign bodies or projectiles. Gunshot flesh wounds usually do well unless complicated with lesions of the vessels and nerves.

Fractures from gunshot wounds are sometimes simple, but more commonly compounded. When *simple*, they are generally caused by blows from spent balls or other projectiles, the bones usually being split or comminuted and contused, the soft parts equally suffering, and the bones, not rarely, being split vertically into a neighboring joint. When *compound* the same comminution and splintering of the bone is commonly present, associated with other complications, such as severe laceration of the soft parts, involving arteries, veins, or nerves, with their attendant dangers, lodgment of fragments, or the whole of the foreign body in the bone or soft parts, and some joint complication from the splitting of the bone into the joint, or from direct injury to the joint.

Military surgeons, however, writes Professor Longmore (in 'Holmes's System'), meet with cases of partial fracture. "1. Removal of portion of a bone by the projectile making a furrow in its passage across its surface, grooving it. 2. Removal by splintering off longitudinal fragments from the external cylindrical part of a bone. 3. Removal of part of the bone by completely punching out a portion, thus leaving a hole through the entire substance of the bone. 4. Partial fracture by driving inwards part of the external cylinder, and causing the fragment to lodge in the cancellated structure, with or without lodgment of the projectile."

Of complete fractures, the peculiarity consists in the comminution, and vertical splintering of the bone, and of the complete removal of some part of the shaft of the bone, the term "resecting fractures" being applied to such. One curious fact occasionally produced by the heavy conoidal ball is noticed in Circular No. VI of the Washington War Department, in which the bone is fissured and comminuted, though less than is common, at the point at which the ball impinges, while at two or three inches above or below this point a nearly transverse fracture of the shaft is produced. In some of the specimens the transverse fracture is not connected by fissures with the fracture produced by the ball. These injuries, probably, are due to balls fired at short ranges.

When conoidal bullets, writes Longmore, happen to strike on or below the trochanters of the femur, they usually leave the head and neck of the bone intact, but cause fissures, which often extend to a long distance down the shaft; when they pierce the head, all the parts below usually escape fracture; when the neck is perforated the fracture generally extends both upwards and downwards. The same rule holds good with regard to the upper extremity of the humerus, although not in so marked a manner.

In all these fractures, from the comminution of the fragments and the concussion the bone has sustained, osteomyelitis and septicæmia are liable to occur, as pointed out by Jules Roux, of Toulon, in 1860 ('Bulletin de l'Académie Impériale de Médecine'), and Longmore ('Med.-Chir. Trans.,' 1865). J. A. Lidell showed that gunshot contusions of long bones are more fatal from this cause than comminuted gunshot fractures ('American Journal,' vol. xlix).

Fractures of the lower extremity are more liable to be followed by such blood poisoning than those of the upper, the susceptibility being much determined by the size of the venous canals; the larger and more numerous the veins of a part, the greater the danger of septicæmia.

In gunshot wounds of the pelvic bones Stromeyer believes the liability to pyæmia to be very great, and that cold and exposure favor its development.

Gunshot fractures of the upper extremity are less fatal than those of the lower, and "unless the bone be extensively injured by a massive projectile, or longitudinal comminution exist to a great extent, especially if also involving a joint, or the state of the patient's health be very unfavorable, attempts should always be made to save the limb."—*Longmore.* When the bone is much splintered an examination by the finger for foreign bodies or detached pieces of bone should be made as well as their removal. Sharp points of projecting spiculæ should be sawn off, the most dependent wound being extended when necessary, or a fresh incision made for the purpose in a dependent position when only one wound exists, the case being then treated as an ordinary compound fracture.

If the shoulder and elbow-joint be opened and the condition of the soft parts, vessels, &c., is not such as to necessitate amputation, excision of the joint should be performed, the experience of all recent campaigns indicating this very strongly.

Gunshot wounds of the wrist too often demand amputation; excision is not expedient, and where the major operation is not imperatively demanded, attempts to save the limb should be made.

The same remarks apply to injuries to the fingers and hand, and only such portions as are irreparably damaged should be removed; for the value of a piece of thumb and one finger, of whatever kind, is hardly to be over-estimated, and every effort should be made to preserve whatever parts can possibly be saved.

Gunshot fractures of the lower extremity are far more grave accidents than those of the upper. Longmore lays it down as a general rule, that ordinary fractures below the knee from rifle balls should *never cause* primary amputation; while, excepting in certain special cases, in fracture above the knee, amputation is held by most military surgeons *to be a necessary measure.*

The special cases are gunshot fractures of the upper third of the femur, especially if it be doubtful whether the hip-joint is implicated or not; as in these, the danger of attending amputation is so great that the question is still open whether the safety of the patient is best consulted by excision of the injured portion of the femur, by removal of detached fragments, and trusting to natural effects for union, or, by resorting to amputation.

The decision of the surgeon must generally rest upon the extent of injury to the soft parts, the age, condition of the patient, and surrounding circumstances. If the femoral artery and vein have been divided, any attempt to preserve the limb will certainly prove fatal.

Amputation at the hip-joint for gunshot wound is generally fatal; so fatal, indeed, that it ought only to be undertaken when the lower limb is so mutilated as to render it a necessity, or when the great vessels have been injured. When any doubt exists as to the probability of saving the limb the operation should be postponed, and undertaken, if necessary, as a secondary amputation.

The experience of all British and Continental surgeons fairly endorses Longmore's conclusions, that in gunshot fractures of the thigh, while the propriety of practising conservatism in the upper third is clearly indicated, amputation is the safest practice in gunshot fractures of the middle and lower third.

M. Legouest, in an essay published in the 'Mem. of the Society of Surgeons at Paris,' believes that amputation at the hip-joint should be reserved for compound fractures complicated with injuries to the great vessels, and he advocates the postponement of the operation as long as possible.

In gunshot fracture of the head of the femur, where the soft parts are not greatly injured nor the bone comminuted, *excision* of the bone may be performed, the only case of recovery in the American war from such an injury being where this practice was adopted. In Circular No. III two such successful cases are recorded out of three, and they induce Dr. Otis to "add that these instances must place excision at the hip for gunshot injury amongst the established operations of surgery." Out of eighty-seven excisions at the hip for injury in America, eight recovered.

In fracture of the thigh the evil of transporting a patient is so great that Stromeyer says, "I have, during the last campaign, lived to see what I expressed a desire for some years ago, when I wrote, 'Above all things it appears to me to be necessary that cases of gunshot fracture of the thigh should not be transported to a distance, but should be carried on a stretcher to the nearest house, and the treatment carried out there.'" He speaks most highly of the conservative treatment of all gunshot fractures. When operation is called for, primary measures should always be preferred both for amputation and excision.

In fracture of the leg, conservatism has even a better chance, that is, where the shaft of the bone is alone implicated; for when the knee is involved, amputation is generally held to be the rule of treatment. Excision should not be entertained, the results of experience condemning the attempt. Langenbeck in gunshot wounds of the knee recommends conservative treatment; amputation being alone required when the soft parts are severely injured and the bones shattered. He lays, also, the greatest stress upon the necessity of fixing the limb in some immovable apparatus, from the moment of the injury to its cure (the plaster-of-Paris splint being preferred), coupled with the application of ice to the part. In gunshot fracture of the shaft of the leg bones not involving joints, the same rules of practice are applicable as have been laid down for the treatment of fracture of the humerus, &c.

In gunshot wounds involving *the ankle-joint*, amputation is the best practice. In exceptional instances where the injury is slight, that is, where the bone is simply split into the joint, an attempt to save the limb may be justifiable. Excision, as a primary operation is not desirable; as a secondary one, where an attempt to save the limb has been made and failed, Langenbeck's experience is in favor of excision, nine out of eleven cases in which he did it after the Bohemian war having recovered; but to obtain this result, he asserts that the complete immobility of the parts involved by means of the plaster-of-Paris splint or one of its congeners is indispensable.

With respect to **amputation in gunshot fractures,** every surgeon since Guthrie's time believes that the *primary* should, as a rule, be preferred to the secondary. This primary amputation should also be performed as soon after the accident as possible. There is no necessity to wait for the effects of the shock of the accident to pass away, and unless the collapse be very severe, the hand of the surgeon need not be stayed. When, however, the collapse is great, some little delay had better be observed, for it is then more than probable that some internal injury or other complication exists to prevent reaction.

Chloroform or any other anæsthetic may be used in military as freely as in civil practice. It has a powerful influence in preventing shock and allowing prolonged or double operations to be performed, which could not otherwise be undertaken, at least without extra risk. In military practice it should be remembered that a limb must often be sacrificed when in civil practice it might be saved; and that amputation is often substituted for excision on account of the impossibility of giving the part the necessary amount of absolute rest and the patient the attention that can only be found in a civil hospital, "for when active operations are proceeding, and it is necessary to carry the wounded to any distance, the advantage of early removal of shattered limbs is obvious, especially when means of rendering the limbs immovable during the transport are defective or the transport itself has to be conducted over rough roads or in unsuitable vehicles, and the hopes of success from conservative treatment are thereby reduced almost to zero."—*Longmore.*

Dr. Gordon, the British commissioner accredited to the French army in the late war between France and Prussia, informs us that the conclusions the bulk of surgeons arrived at as regards amputation were, that it was more suited than excision or re-section when its subject had to be carried on with the army; that excision and resection were much more likely to be successful when practised in the upper than in the lower extremity; that excision of the knee, as a substitute for amputation in case of gunshot wounds of that articulation, has sadly failed; that the practice of conservative surgery in stationary hospitals furnishes no criterion of its suitability in movable hospitals, its requirements involving such attention from the surgeon as can alone be fully carried out when there are comparatively few cases of severity to attend to; and that in many cases, where the limbs are saved, they are relatively of little use.

Mac Cormac urges that the mortality after primary is so very much smaller than that attendent on secondary amputation, that this point cannot be too strongly insisted upon.

CHAPTER XXXV.

ANÆSTHETICS.

WHEN Sir H. Davy's attention was drawn in 1798 to Priestley's nitrous oxide gas by Dr. Mitchell's theory that this gas "was the principle of contagion, and capable of producing the most terrible effects when respired by animals in the minutest quantities, or even when applied to the skin or muscular fibre," and when he with Southey, the then Poet Laureate, and Coleridge, the philosopher, inhaled it with sufficient frequency "to establish the fact that the gas possesses an intoxicating quality, to which the enthusiasm of persons submitting to its operation has imparted a character of extravagance wholly inconsistent with truth" ('Life of Davy,' by Paris, 1831), he little thought that he was then laying the basis of experimental investigations that were to form an epoch in the history of the world or rather of mankind, and to end in the introduction into practice of a new power, which, being of inestimable value to the general public, is of nearly equal value to the medical profession, and has been the means of revolutionizing surgery to an extent which few are aware of; for the "most terrible effects" with which this gas was credited have been transformed into the beneficial effects brought about by anæsthetics.

In the present work, I have neither space nor inclination to go fully into the history of the subject. To the works of Snow, Sir James Simpson, Sansom, Druitt, Holmes, Dr. Marion Sims, MM. Perin, and Lallemand, I must refer the reader for full particulars on this subject. I shall content myself by recording the fact, that Dr. Crawford W. Long, of Athens, Georgia, was the first surgeon who, in March, 1842, performed a surgical operation while the patient was completely anæsthetized by the inhalation of sulphuric ether. Dr. Marion Sims ('Virginia Medical Monthly,' May, 1877), remarks "That the honor of the first public and authentic trial of surgical anæsthesia, by the aid of means newly discovered, belongs to an entirely obscure dentist, Horace Wells, of Hartford, Connecticut" (M. Perrin), this dentist having employed Davy's nitrous oxide gas in dentistry in 1844 with an excellent result. In 1846, Morton, Wells's late partner, introduced into practice at Massachusetts Hospital the use of sulphuric ether, probably on the suggestion of Dr. Jackson. In 1847, our own Lawrence, of St. Bartholomew's, on the suggestion of a student, Mr. Furnell, now Principal of Madras Medical College, used chloric ether for the same purpose ('Holmes's Syst.,' vol. 5, Ed. 2), and in the autumn of the same year, Sir James Simpson gave to the profession the active principle of the chloric of ether, the chloroform, on the suggestion of Mr. Waldie, of Liverpool, and since then this drug or ether, separately or combined, has been in general use.

Other anæsthetics, however, have been introduced, the bichloride of methyline being the most popular.

How anæsthetics act upon the body is not yet determined, although it is tolerably certain that the ultimate result is absolute paralysis of the nerve centres, cerebral and spinal. To this end a patient passes through, *first*, a stage of cerebral excitement; *next*, cerebral insensibility and loss of sensation; *thirdly*, loss of voluntary motion; and, *lastly*, of reflex action, the brain losing its power before the spinal cord; absolute paralysis and anæsthesia existing only when both nerve centres are completely under the influence of the inhaled drug, the nerve supply of the respiratory and circulatory systems alone excepted. Indeed, it is upon this fact that the practical value of all anæsthetics is based, the surgeon aiming at producing paralysis of the muscles of the trunk and extremities only, and not those of the respiratory or circulatory systems. In a general way, there is a wide interval between the two stages; in exceptional instances this interval is abridged; in such the heart and respiratory system suddenly become affected, and it is under these circumstances that sudden death takes place.

Chloroform, like many other drugs, does not act alike in all individuals, some being very susceptible to its influence whilst others are the reverse. Like all anæsthetics, it increases at first the force of the heart's action, although this effect is slight and transient, the heart acting with less than its natural force when complete anæsthesia is produced. When a patient is brought quickly under the influence of an anæsthetic the heart's action may be suddenly arrested, Brown-Séquard believing that under such circumstances "it is by the reflex influence due to the sudden irritation of the branches of the par vagum in the lungs that chloroform has killed in the very rare cases in which the heart's action had been stopped before the respiration." ('Lect. on Phys. of Nerv. System.')

Moderate doses of chloroform tend to weaken the heart's action after their first stimulating effects have passed away, the respiratory act usually ceasing before the circulatory when death is the result. Thus danger increases with the degree of stupor produced.

Ether is said not to depress the action of the heart to the same extent as chloroform. Of late it has grown rapidly into favor, and it is said by its advocates to be more safe than any other anæsthetic. It should be given with sufficient freedom to bring the patient under its influence before the blood becomes saturated.

When the upper eyelid can be raised without muscular resistance and no muscular contraction is caused by touching the cornea, the patient is, as a rule, sufficiently under the influence of the anæsthetic for surgical purposes.

Respiration generally, but not invariably ceases before the action of the heart, and death may be due either to the failure of the heart's action or to that of the respiratory function.

After death, all the cavities of the heart are distended; the cases in which the left side is empty being only exceptional. Chloroform is more commonly fatal in the struggling stage than in any other.

Billroth asserts "that during the stage of excitement violent muscular efforts may give rise to apoplexy, especially in individuals with disease of the heart, rigid arteries, or emphysema. Of most consequence in this stage, however, are the contractions of the muscles of mastication and the posterior muscles of the tongue. By means of the stylo-glossi and the glosso-pharyngei the tongue is drawn spasmodically backwards, pressing the epiglottis down so as to close mechanically the aperture of the larynx. Such patients become blue in the face, and die suffocated, not through the direct action of the chloroform, but from the mechanical privation of air," unless the tongue be well drawn forwards, or chin tilted upwards.

Anæsthetics affect the brain of different people in as many
will be quarrelsome, a second violent, a third sentimental,
cholic, or merry.

In epileptic subjects, I have seen patients pass through
during their progress towards narcosis.

The best rules for the administration of chloroform, ether,
given by the Chloroform Committee of the Royal Medical
London, 1864. It was my privilege to act as one of the me
my subsequent experience has convinced me of the value of th
I quote them in full with only a few modifications.

RULES RELATING TO THE ADMINISTRATION OF CHLOROFOR

Chloroform should on no account be given carelessly or
when complete insensibility is desired, the attention of its ad
sively confined to the duty he has undertaken.

Under no circumstances is it desirable for a person to give

It is not advisable to give an anæsthetic after a long fast,
time for its administration being four or five hours after food

If the patient is much depressed, there is no objection to
brandy, wine, or ammonia, before commencing the inhalatio

Provision for the free admission of air during the pati
necessary.

The recumbent position of the patient is preferable; the p
to the administrator, but entails no extra danger. In the e
is danger from syncope. Sudden elevation or turning of the

An apparatus is not essential to safety if due care be tak
Free admixture of air with the anæsthetic is of the first im
this, any apparatus may be employed. If lint, or a handke
should be folded as an open cone, or held an inch or an inch

Chloroform should invariably be given slowly. Sudden i
anæsthetic is most dangerous. Three and a half per cent. i
per cent., with 95½ of atmospheric air, is the maximum of
required; given cautiously at first, the quantity within this
according to the necessities of the case, the administrator be
on the patient than by the amount exhibited. Ether may b

The administrator should watch the respiration of his pati
free for careful observation of the pulse.

The patient who appears likely to vomit whilst beginning
be at once brought fully under its influence, the tendency to

The occurrence, during the administration of an anæsthe
of the patient's countenance, or sudden failure or flickeri
shallow respirations, indicates danger, and necessitates i
anæsthetic until such symptoms have disappeared.

On the occurrence of these symptoms, and especially if
as to threaten death from failure of respiration, of the heart
the following rules of treatment should be observed:—

Allow free access of fresh air, pull forward the lower jaw
clear the mouth and fauces, keep or place the patient recum
face and chest, and aid the respiratory movements by rh
thorax. Nélaton and Marion Sims advise the inversion
throwing what blood there is wholly to the brain, on the theo
is, as a rule, due to syncope, or to cerebral anæmia. In the
mence instantly with artificial respiration, whether the respi
pulse and the respiration together. Galvanism may be used
ration, but artificial respiration is on no account to be delaye
galvanism may be tried.

In extreme cases laryngotomy may be required.

Few, if any, are insusceptible to the influence of anæsthe
being required to induce anæsthesia. The time varies accor
habits.

The mixture of alcohol 1 part, chloroform 2 parts, and e in the same way as chloroform alone, care being taken, when lint or a handkerchief is used, to prevent the too free escape of the vapor. I think highly of this mixture.

USE OF ANÆSTHETICS IN SURGICAL OPERATIONS.

With heart disease they may be given in any case which requires an operation, though when there is evidence of a fatty, weak, or dilated heart great caution is demanded. Ether is probably under these circumstances, the better vapor to employ. Valvular disease is of less importance.

In phthisis, when an operation is unavoidable, anæsthetics may be given with impunity.

For all operations upon the jaws and teeth, the lips, cheeks, and tongue, anæsthetics may be inhaled with ordinary safety. By care and good management, the patient may be kept under their influence to the completion of the operation. In these cases, blood, as it escapes, if not voided by the mouth, passes into the pharynx. If any small quantity finds its way through the larynx, it is readily expelled by coughing. In operations upon the soft palate, fauces, pharynx, and posterior nares, if sudden or severe hemorrhage is likely to occur, it is not advisable to induce deep insensibility. In cases requiring laryngotomy and tracheotomy, anæsthetics may be employed with safety and advantage.

For operations upon the eye, involving the contents of the globe, the use of anæsthetics is open to objection, on account of the damage which the eye may sustain from muscular straining or vomiting. If employed, profound insensibility should be induced. Recent experience tends rather to prove, that anæsthetics may be used without fear in most eye operations.

In operations for hernia, and in the application of the taxis, anæsthetics act most beneficially. For most operations about the anus and perineum, profound anæsthesia is positively demanded.

In the condition of shock or of great depression as after hemorrhage, the careful administration of anæsthetics diminishes the risk of an operation.

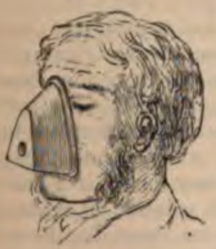
In all cases other than those specially referred to, it is sufficient to state, so far as a mere surgical operation is concerned, that anæsthetics may invariably be administered.

The continuous vomiting occasionally induced by and following upon, the inhalation of anæsthetics, may be injurious by consequent exhaustion, as well as by mechanically disturbing the repair of a wound. With this reservation, they do not appear to interfere with the recovery of patients from surgical operations.

Statistics.—The results of 2586 capital operations performed before, and of 1847 performed since, the introduction of anæsthetics, which I collected from all authentic available sources show that the rate of mortality has not been increased, even though much graver operations have been done under the influence of anæsthetics. The risk attending the inhalation of chloroform is very small, being about 1 in 3000 administrations. This is enough to forbid its use in trivial cases, but not enough to do so in cases of capital operation, or where for purposes of diagnosis it is required. In children it is very safe.

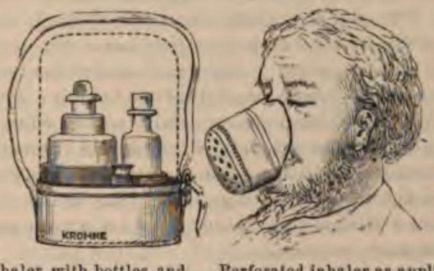
The best common instrument for the administration of chloroform is that employed at Guy's, which I introduced in 1864, having had it made after a pattern suggested by Dr. Parker, late of the London Hospital. It is not complicated by any valves, but is merely a mouth and nose-piece lined with lint, with openings to admit air freely (Fig. 609). Within the last few years, Skinner's inhaler, composed of a framework of wire, covered

FIG. 609.



Chloroform inhaler.

FIG. 610.



Inhaler with bottles and strap complete.

Perforated inhaler as applied. Rendle's inhaler as improved by Morris.

with a layer of flannel, fastened to the frame by a gusset and tape, and a handle, has found much favor, and is very useful.

Clover's apparatus is, however, very good when it can be obtained. It is composed of an india-rubber bag into which chloroform or any other anæsthetic is pumped, mixed with atmospheric air. Clover employs 3 or 4 per cent. of chloroform. It is, however, a cumbersome apparatus, and cannot be at universal command. When he gives nitrous oxide gas at first and follows it up by ether, his apparatus is equally satisfactory. For ether or the anæsthetic A. C. E. mixture the leather bottle-shaped apparatus, as suggested by Dr. Golding-Bird, or the one figure above as made for Mr. Rendle and improved by Morris (Fig. 610) is very valuable.

The bichloride of methyline is recommended to our notice as an anæsthetic of great power. Patients are said to be brought under the influence of the drug in twenty or thirty seconds, and to recover from it rapidly with little inconvenience. No sickness or headache is said to follow its use, unless the inhalation has been continued for many minutes, or a second dose is given to keep up the effect. Of course, if the inhalation be prolonged, the after-effects resemble, though in a less degree, those of chloroform, save the one—absence of muscular excitement.

"The rapidity of action of the drug and recovery appears," writes Rendle, "to be due to the great volatility and solubility, enabling a large quantity to reach and escape from the nerve organs at once; its safety, to its rather stimulant action on the heart, and its rapid elimination." The bichloride being very volatile, requires to be kept in a well-stoppered bottle; and it is an advantage to keep it in the dark, inverted under water.

Mr. Rendle claims for its use the following advantages: The patients retain their normal color and appearance; the anæsthesia is good, is rapidly induced, and can be maintained for any length of time; the recovery is rapid and complete; there is no unpleasant after-symptoms, nor muscular rigidity. He says it is also at least as safe as chloroform. At Guy's Hospital, it is in common use for eye surgery, where a few minutes are only required for the anæsthesia, but in the wards generally chloroform or ether is the favorite.

In abdominal surgery, such as ovariotomy, Keith has said that ether is less prone to be followed by sickness than chloroform, and, if the success of an operation is any argument in its favor, Keith's must be quoted. I have for some years employed the mixture recommended by the Chloroform Committee—of Alcohol, Chloroform, and Ether—and think well of it. I believe it to be as good as chloroform, and less likely than any other to be followed by that bane of all anæsthetics, vomiting.

In the operations of dentistry and all short measures, the nitrous oxide gas is of great value.

After the use of any anæsthetic, everything should be given cold for twelve or twenty-four hours to prevent sickness; ice, indeed, may be sucked with advantage; and ice and milk is a very favorite mixture. If hot food be given, vomiting is far more likely to appear, or to be aggravated.

Anæsthetics, however, have other uses than the destruction of pain. As aids to diagnosis they are of priceless value, both to the physician and surgeon. To the surgeon they have also opened up new fields for his scientific art which were formerly but little known. I shall point them out, however, but briefly, quoting from a lecture I had the honor of delivering at the Hunterian Society in 1870:—

"Chloroform as an aid to diagnosis stands second to no means which we have at our disposal. To the physician who has a difficult case of abdominal tumor, what facilities it gives him for its thorough investigation. Suspected tumors become phantoms; so-called movable kidneys slide away; and indefinite conditions become clear and intelligible. With how much greater certainty a physician can think over a doubtful case, decide upon its nature, deliver his opinion, and treat it when he has adopted this means of investigation. In hysterical subjects, it renders a thorough abdominal examination a possibility, when no such previously existed; and in what class of cases, may I ask, is it more necessary to make a positive diagnosis than in this? In my own practice, it enabled me on one occasion to make out a pregnancy when an ovarian tumor had been diagnosed by men whose authority was undoubted, and in a patient whose position in life rendered the suspicion of pregnancy almost a libel. Indeed the ovarian nature of the disease was looked upon as so decided, that my aid was sought solely for the operation. In this case an examination of the abdomen was impossible, from hysterical sensibility; but under chloroform, all difficulties disappeared. To the physician-accoucheur may I not also assert it to be equally valuable for diagnostic purposes? To answer this fully is out of my province;

but I have known a case of cystic disease of the uterus, which was about to be operated upon as an ovarian tumor, made out by the use of the uterine sound, with the patient under chloroform, when an examination by the same instrument made before had failed to yield any such evidence. In the surgical diseases of children is it possible to over-estimate its value? With what gentleness can difficult examinations be now made of injured limbs; and with what certainty can we now apply our treatment! In sounding for stone what facilities it affords! In general surgery, what new fields has it not opened? Where would ovariotomy have now been, may I ask, had not chloroform been in use? Would it have been an established operation in surgery? Could it have been so successful? The answers to these questions, I think are plain; they must be in the negative. It is true the operation had been performed before its introduction; it had been successful in a few cases, but it had almost fallen out of practice; its revival was due, without doubt, to chloroform, and its present established position to the general use of that drug. No operation requires more gentleness and nicety; and how could these essential points of practice be applied with a patient writhing under the agonies of an abdominal section? To all abdominal surgery the same observations are applicable, although they may not tell, perhaps, with the same force.

"Let us now refer to another class of cases; to that large one known as belonging to plastic surgery. How many cases of vesico- or recto-vaginal fistula were successfully treated by operation before chloroform was introduced? At Guy's Hospital I can find no record of such. The physician-accoucheur used to cauterize the margins of the fistula, it is true, but, I fear, with poor success; for I have never heard of a case of any size being so cured. At the present day these cases are now to be cured by operation with as much certainty as any other class. They have in truth been moved from the incurable to curable affections. And yet these instances of plastic surgery are only a portion of those which I might enumerate.

"In the treatment of deformities about the mouth, nose, and eye; in the division of cicatrices after burns; in the treatment of ruptured perineum, with all its complications—what innumerable cases might be quoted now, against the few of former times?

"Again: in the operations of bones and joints, how many of the improvements in our practice are there that may not be put down to the use of chloroform?—operations for necrosis in particular. How rare these were, and how unsatisfactory they must have been before its introduction! I can recall a few which I saw in my student's days with no pleasant feeling. How common they are now, and how successful! Taking Guy's as a type of the metropolitan hospitals, an operation for necrosis can always be found for operating days—the operation is so frequent and so satisfactory. In the removal of bone from joints, in the excision of joints, it is only fair to believe that a great part of the success which now attends the practice is to be attributed to the use of an anæsthetic? How many hands and feet, which would formerly have been sacrificed, are now saved by the removal of diseased bone, it is difficult to estimate. Would Sir W. Fergusson have framed the phrase 'conservative surgery,' and could it have been adopted, before the introduction of chloroform?

"In the treatment of aneurisms, have not like improvements to be recorded? Has not chloroform rendered possible the cure of aneurism by pressure? Has it not also rendered the practice of torsion of arteries for the arrest of hemorrhage a practical success, thus simplifying surgery? How many cases of strangulated hernia are now reduced, which in former times would have been submitted to strange treatment and to a delayed operation? How simple it has comparatively rendered the reduction of recent dislocations! Where are now the pulleys, the ropes, and the other frightful mechanical appliances, that were used of old for the reduction of dislocations of the hip, shoulder, and other joints? Are they not decaying in the lumber-rooms of our hospitals? and has not the use of chloroform made the reduction of dislocations by manipulation a reality? On one occasion I reduced with ease, by manipulation, a dislocation of the elbow-joint backwards, complicated with fracture of the humerus, which would probably have been left unreduced before the introduction of the anæsthetic, and more recently the head of the humerus dislocated on to the dorsum of the scapula, complicated with fracture through the tuberosities.

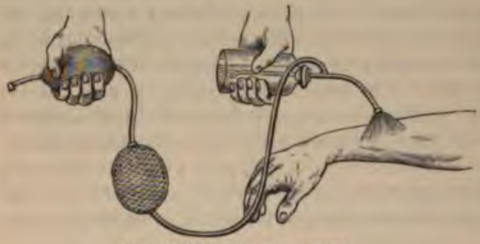
"Let us contrast for one moment the operation of perineal section for stricture as it was and as now performed. Do we not all remember it as one of the most unsatisfactory and unsuccessful of surgical operations? Do not we know it to be one of the most satisfactory and successful? Indeed I might continue the contrast between the pre-anæsthetic period and the present; but I think I have said enough to show that to the introduction of chloroform many of our best improvements in surgical practice are to be attributed.

For the surgeon it does away with all excuse, if any ever existed, for hurry in an operation. He can take his steps in it with deliberation, and make it a certainty. We never see now, happily, a theatre full of spectators observing the operation watch in hand; and I trust there are few, if any, surgeons who at the present day sacrifice safety and certainty in their operations for expedition and display. The use of anæsthetics has rendered the practice of surgery safer, surer, and more scientific. It has removed difficulties from the practice of our art which before were insurmountable, and has rendered possible innumerable things that could not in former times have been entertained."

Local anæsthesia may be brought about by freezing a part, as suggested by Dr. J. Arnott, or by means of the rapid evaporization of pure anhydrous ether, as practised by Dr. B. W. Richardson. Both are valuable means of diminishing pain where anæsthesia by inhalation is forbidden or inapplicable. Arnott's plan is carried out by mixing up finely pounded ice in a gauze net or thin translucent india-rubber bag, with half its bulk of powdered salt, the net being placed over the part to be benumbed. If well applied, it renders the skin at once pale and bloodless, and if continued, of a tallowy death-like aspect; when too long applied it may produce frost-bite or chilblain.

Dr. Richardson's ether spray is a more elegant, as it is a more effectual, mode of applying local anæsthesia than ice. It is worked by his well-known apparatus, consisting of a tube with india-rubber ball and second spring ball to make the current continuous, the air being pumped in through this tube into a bottle containing anhydrous ether of a sp. gr. 0.723 and of a boiling-point of 96° Fahr. Through the stoppered neck of this bottle a glass tube is passed, which reaches at one end nearly to the bottom of the bottle, and at the other, is fitted with a point, with one or more perforations through which the ether is forced in a fine spray, this spray being directed upon the part to be benumbed (Fig. 611).

Fig. 611.



Dr. Richardson's apparatus.

For opening abscesses, taking out small tumors, the removal of external piles, and other minor operations, this local anæsthesia is of great value; but in graver surgical acts, it is inapplicable, as it only affects the surface and is but skin-deep in its influence.

CHAPTER XXXVI.

AMPUTATION.

When a limb is saved by the excision of a joint, and life prolonged by the application of a ligature to, or the torsion of a wounded or diseased artery, surgical science claims a triumph; and surely an equal triumph ought to be accorded to her, when, by the removal of a part that interferes with its duties, life is rendered more valuable; or by the amputation of a limb that is irreparably injured, or diseased, death is averted. To say that amputation is an opprobrium of our art is to take a narrow view of its objects, since as the first object of the surgeon is *to save life*, the necessary sacrifice of a limb becomes the truest "*conservatism*." To sacrifice a limb unnecessarily is an error which the surgical mind would never willingly commit, although to sacrifice life in the feeble effort to save a limb is one of far greater magnitude. It is an error, however, that timid surgeons are too likely to fall into when inoculated with the narrow views of a spurious conservatism, since to leave a limb alone with the hope of saving it is a passive act of the professional mind that requires no effort; while to make up the mind to act requires courage, backed up with knowledge and a full sense of responsibility. The operation of amputation itself requires nicety and well-applied mechanical skill; but to determine upon its necessity or otherwise requires a high order of knowledge, a careful balancing of probabilities, and much decision.

It is not my intention to discuss, in the present chapter, the conditions under which amputation may be called for, since these have been fully considered in the different chapters devoted to such injuries and diseases as may require this treatment. I propose simply to consider amputation as an operation, to point out the best modes of its performance under the different conditions in which it may be demanded, and to describe the various forms of operation as applicable to different parts.

To supply the history of amputation would be an interesting but a too extended process. In 'Cooper's Surgical Dictionary' and 'Holmes's System' two able articles will be found upon the subject which contain all that can be desired. For the present purpose it will be enough to state that the first amputations were performed by the *circular method*, the soft parts being divided down to the bone by a circular sweep of the knife (*vide* Celsus), the hemorrhage being arrested by the red-hot iron, and the bone divided by a saw.

About 1718 J. L. Petit, the French surgeon, who improved the tourniquet now known by his name, as well as our own great surgeon, Cheselden, suggested that the skin and fat of the limb to be removed, should be first cut through and retracted, and then the muscles and bones divided as high as they were exposed. Still later, Louis, of Paris, adopted the practice of dividing by the first cut the skin and superficial layer of muscles, by the second, the deeper muscles down to the bone, at the line of the retracted superficial layer, and lastly, the bone itself. He also used a retractor.

In 1779, Alanson, of Liverpool, made a still further advance by cutting the integument as usual and allowing it to retract, and then dividing the muscles obliquely upwards, cutting from without down to the bone, more after the modern flap operation, the bone being subsequently divided. The soft parts in this operation on being brought down formed a conical cavity with the bone at the apex, Alanson's object having been to prevent the sugar-loaf stump. Still later, Benjamin Bell, of Edinburgh, and Hey, of Leeds, secured the same end by first dividing the integument with a circular cut and dissecting it up; then the muscles at a higher level; and, lastly, this being divided at a point considerably above the line of the retracted muscles. Hey, moreover, in the thigh amputations suggested the expediency of dividing the posterior muscles longer than the anterior, to compensate for their greater retraction.

The *flap operation* is more modern than the circular, and to Mr. James Young, of Plymouth, is due the credit of having first published in 1678, the method which he informs us he had "from a very ingenious brother of our," Mr. C. Lowdham, of Exeter. He made one flap only of skin, divided the muscles by the circular plan, and stitched the parts together. Eighteen years later Verduin, of Amsterdam, made the first muscular and skin flap by perforating the limb and cutting outwards (transfixion).

To Liston, must be attributed the credit of having fully established the flap operation, and in the pre-anæsthetic period when time was a point of consideration, the expedition with which amputation could be performed by transfixion compared with the tediousness of the circular operation tended much toward this end. It was thought, moreover, that a large mass of muscle formed a good covering to the bone, and yielded a better stump than that in the circular. Experience, soon proved, however, that this opinion was not supported by facts, that the supposed advantages were not real, and did not compensate for the larger extent of wound caused by the flap operation, and for the evil of often having to tuck in the projecting ends of the divided muscles before the integuments could be adjusted. Liston saw this before he died, and was led with Syme to modify his operation, making in muscular subjects two lateral crescentic skin flaps with their convexity downwards, and dividing the muscles as in the circular method. This operation is by far the best for all amputations of the leg and forearm.

In more modern times, Lowdham and Young's practice has found expression in Carden's operation, while Teale's amputation must be regarded as a modification of the flap. Both these gentlemen, however, advocated the long anterior flap in preference to all others, Teale making two rectangular flaps of unequal length of the skin and muscle (Fig. 617), and Carden, a rounded anterior flap of the skin alone (Fig. 618); and under certain conditions, nothing can be better than the results obtained, the line of cicatrix being posterior to the extremity of the stump and out of harm's way, thereby allowing the patient to rest part, if not all, his weight upon the stump.

The chief objections to the operation consist in the tendency there is for a long skin flap to slough, and the necessity of dividing the bone at a higher level than would be required in the circular operation, when a long flap cannot otherwise be made. In muscular subjects this last objection is serious, and fatal to the operation in many thigh amputations; for it is a truth that cannot be too forcibly recognized, that in the thigh, the danger to life is increased with every inch of bone removed. The surgeon who invariably

conditions, and that *bad* stumps follow the amputation of a limb in which the state of the flaps promised to bring about a favorable result. To assert that the form of amputation, or rather that the shape of the flap, &c., has anything to do with the relative mortality of different amputations is incorrect. What evidence exists, points to a different conclusion, for the success of an amputation as of any other operation, turns more upon what in recent times seems to have been forgotten, viz., the conditions of the *viscera*, the *age*, and general state of the subject, accepting the facts that the older the patient the greater the danger, and the more of the body that is removed, the greater the risk. My own conviction is, that however desirable it may be to obtain a model stump, the end is not sufficiently certain or important to justify the surgeon in adding one tittle to the risk of the operation, or in sacrificing more of the limb than the necessities of the case demand. I regard it as bad and unjustifiable surgery to perform a Syme's or a Pirogoff's amputation when a Chopart's will suffice; to amputate a leg when the removal of a foot at the joint will answer the purpose; to remove a leg or thigh an inch higher than is absolutely called for, in order to execute what may be looked upon as a good operation or to gratify a fancy; to amputate through the condyles of the femur when an amputation at the knee-joint can be performed, or through the shaft of the femur when the like end may be secured by cutting through the condyles. The surgeon must ever look upon the operation of amputation as an unfortunate necessity, and should bear in mind that it is to be undertaken only to save or prolong life, or to add to life's usefulness. With these ends in view, he should not add one jot to its dangers, or take away an inch more of the body than is essential. The beauty of a stump may be something in itself, but is nothing if it is to be obtained by increased danger, and the brilliancy of an operation is a snare that should never be allowed to draw the surgeon away from the main object—the preservation of life—which alone gives the operation of amputation a high and scientific position in surgical practice.

The mortality of amputation is more determined by age than anything else, and the credit of having statistically proved this fact is due to Mr. Holmes ('St. George's Hosp. Rep.,' 1866 and 1877). In my own paper on the causes of death in amputation ('Med.-Chir. Trans.,' vol. xlii, 1859), this point was overlooked; but, following Mr. Holmes's example, I re-analyzed the cases on which it was based, and have been somewhat startled at the very definite conclusions brought out by my analysis. Thus—

Out of 103 cases under 20 years of age, 10 died, or 1 in 10.
Out of 111 cases between 21 and 40 years of age, 21 died, or 1 in 5.
Out of 74 cases over 40 years of age, 22 died, or 1 in 3½.

The mortality of amputation between the ages of 20 and 40 being exactly twice as great as before 20 years of age.

Mr. Callender ('Med.-Chir. Trans.,' vol. xlvii, 1864) and Mr. Holmes's combined statistics reveal the same results:

	Cases under 20 years of age.	Between 20 and 40 years of age.	Over 40 years of age.
Callender's . .	61 cases, 3 died.	92 cases, 20 died.	74 cases, 30 died.
Holmes's . .	130 " 22 "	215 " 68 "	155 " 68 "
	191 cases, 25 died, or 1 in 7½.	307 cases, 88 died, or 1 in 3½.	229 cases, 98 died, or 1 in 2⅓.

Fifty-two deaths having occurred in 250 cases reported by Mr. Holmes in subjects under 30 years of age, and 106 deaths in 250 cases operated upon after 30 years of age.

If the causes of amputation are looked at in the same light, the results become still more marked, for dividing them into amputations for disease, accident, and expediency, the latter term including amputations for tumors, deformity, &c., the following facts are elicited:

	Diseases.			Expediency.			Accidents.		
	Cases.	Died.		Cases.	Died.		Cases.	Died.	
Under 20 years of age	68	4,	or 1 in 17.	9	3,	or 1 in 3.	26	3,	or 1 in 9.
Between 20 and 40 .	66	12,	or 1 in 5½.	15	4,	or 1 in 4.	30	5,	or 1 in 6.
Over 40 . . .	33	5,	or 1 in 6½.	9	3,	or 1 in 3.	32	14,	or 1 in 2⅓.

Amputations for *acute* suppurative disease are most fatal, and should only be undertaken when a strong necessity exists. I pointed this out in 1859, but it is not a fact sufficiently recognized.

Amputation in young life for chronic disease is most successful, being three times more so than at a later period, one only in every seventeen dying; amputation for accident increases in fatality with age; and amputations of expediency are as dangerous at all periods of life as traumatic amputations are in the aged.

Mr. Callender has also well shown ('St. Barth. Hosp. Rep.,' 1869) that the mortality of amputations is much alike, whether performed in country hospitals, in country private practice, or in country cases in London. In amputations on London subjects, as in the subjects of all large towns, the mortality is somewhat higher.

Dr. Steele has, however, gone further, and proved by figures, that amputations performed in London for injury on country patients are, as a rule, more favorable than when performed in town cases, the difference between the two classes being far less marked in amputation for disease than for injury ('Guy's Hosp. Rep.,' 1869–70).

The causes of death after amputation are as follows, taking these conclusions from my paper on the subject ('Med.-Chir. Trans.,' 1859), to which the reader must be referred for further detail. *Shock and exhaustion* claim one-third of the fatal cases, and one-twelfth of all amputations. *Pyæmia* was the cause of death in 42 per cent. of the fatal cases, and in one-tenth of all amputations. *Secondary hemorrhage* in 7 per cent. of the fatal cases, or 1½ per cent. of the whole number. Some *complication*, cerebral, thoracic or abdominal, causes death in about 4 per cent. of all cases. Pyæmia is nearly twice as fatal after amputations of expediency as after those for disease or primary amputations, but is less fatal after secondary amputations than any others. In amputation of the leg it is twice as destructive as in that of the thigh, the larger section of bone being the more dangerous. In primary amputation of the leg, it is more fatal than when performed for disease.

How far the deaths from secondary hemorrhage will be diminished when the practice of torsion of arteries is more general remains to be proved, although from the experience we have had at Guy's Hospital the promise of a better result is very great. Up to the end of 1874 we have had 200 consecutive cases of amputations of the thigh, leg, arm, and forearm, in which all the arteries had been twisted (110 of them having been of the femoral artery), and no case of secondary hemorrhage—indeed, our house-surgeons never expect to be called to cases of secondary hemorrhage now that torsion is the general practice of the hospital.

The operation of amputation may be called for on account of some incurable disease or incurable injury. When performed for the first cause, the operation has been described as a *pathological* amputation, when for the second, *traumatic*. Both classes are also subdivided, the pathological into amputations for suppurative disease of bones and joints—pure *pathological* amputation; and into those for talipes, tumors, deformities, &c.—amputations of expediency.

Traumatic amputations performed during the first twenty-four hours after the accident before any inflammatory complications have set in, are called *primary;* the term *secondary* is applied to the same class of cases after suppuration has appeared; the word *intermediate* being employed to designate amputations performed twenty-four hours after the accident, but before suppuration has declared itself. This distinction, however, is not a satisfactory one.

Some statisticians have classed the secondary amputations with the pathological, but this practice is clearly wrong.

THE DIFFERENT MODES OF AMPUTATION

may be divided into three great classes—1st, the *circular;* 2d, the *flap* operation, whether by transfixion or cutting from without inwards—Teale's amputation (consisting of one long anterior skin and muscular flap, and short posterior), being looked upon as a modification of the ordinary flap operation; 3d, the *mixed form* of amputation—skin flap, and circular cut through muscles—Carden's operation being included in this series. Into one or other of these classes almost every form of amputation may be brought, although practically there are innumerable modifications of each, more particularly of the flap.

The old circular, as already described (p. 903), is now fairly abandoned. It has no advantages over the more modern mixed form of amputation, and will not take the place of the flap where the latter is applicable. In small limbs, where there is but little muscular tissue and a single bone to divide, it may be performed, but cannot be recommended. It is more practised abroad than in this country.

The flap operation doubtless owes its popularity as much to Liston, Lisfranc, and Velpeau, who were its strong supporters, as to the facility with which it is performed, and the satisfactory appearance of the flaps at the time of the operation. Before anæsthetics were introduced, expedition was of importance, and it was the surgeon's aim to remove a limb as rapidly as possible. "The surgeon operating by the watch took off a limb by the flap operation in as many seconds as there were minutes occupied in the old circular method."—*Sir W. Fergusson.* Since 1846, however, when anæsthesia came into vogue, this necessity has ceased to exist, and surgeons have been led away more from the flap operation to what may now be described as the mixed.

In certain parts, however, the flap operation still holds its ground, and, in a general sense it may be said, that in operations where *the shafts of single* bones or some joints are involved, it is the best method; while in some localities, as at the shoulder and hip-joints, it is the only one open to the surgeon.

The objections to the flap operation are the large surface that is exposed, the danger of puncturing or slitting the main artery of the part, the inconvenience of bleeding, the leaving of the main artery and nerves in one of the flaps, and the disadvantage of a thick muscular flap.

The flap amputation has, however, one great advantage, and that is, its capability of innumerable modifications. Thus, both flaps may be made by transfixing—the old plan; both may be made by cutting from without inwards; one flap, the anterior, may be made by the latter method, and the second or posterior, by transfixion; or lateral flaps, single or double, or oval flaps, may be made.

The *advantages* of transfixing the flap consist in the rapidity and cleanliness with which the section of the muscles and deeper parts is made; its *disadvantages*, in the irregularity with which the skin is too often divided from the elastic integuments stretching before the knife. By the plan of cutting the flap from without inwards, this disadvantage is, however, neutralized, while an extra advantage is gained, for the surgeon can often cut a longer skin than muscular flap, which in large limbs is a matter of importance.

In some amputations, as of single bones, the operation may be performed by cutting the anterior flap from without inwards, and the posterior by transfixing. In the arm and thigh, when I select the flap amputation, this method is that which I usually adopt. In cutting the flap by transfixion, particularly in the thigh, the surgeon should always support it with his left hand, and, when a sufficient flap has been made, cut sharply outwards (Fig. 613).

Sir W. Fergusson says, with respect to the flap operation, "if, in transfixing, the flaps be made purposely short, and then, retraction being made, the knife be carried round the exposed tissues which cover the bone, a cone will be formed resembling that in the ordinary circular operation, and thus by a combination, a compromise of the two methods (the circular and the flap), a covering to the end of the bone, in other words a stump, will be left superior, in my estimation, to any other," "though," he adds, "that cutting from without inwards is in many instances followed by the best results." (Lect. on Prog. of Surg., 1867.)

Besides these recognized forms of amputation, many others are performed, the surgeon having too often "to cut the flap according to the tissues," particularly in cases of injury. He has to utilize what skin there is left uninjured in order to prevent the necessity of amputating higher up; it may be that one external or internal flap can be made, one anterior or posterior—in fact, any form or combination of flaps the surgeon may be called upon to make to carry out the object he has in hand, viz., the removal of the part that must be removed and no more, with the least sacrifice of parts. Indeed, as already stated, under rare circumstances, an amputation may be best performed without flaps, or with poor ones, it being a safer, and, I believe, a sounder practice to take off a part that *must be* removed to save life, immediately above the seat of injury, even with bad, poor, or no flaps, than for the sake of making flaps that may slough, to amputate higher up, possibly with the sacrifice of a joint, and by so doing to incur an unnecessary danger to the life we are operating to save, Petit's fundamental rule being far from true, that "as little of the flesh should be cut away as possible, but the more the bone is removed the better." ('Traité des Malad. Chir.,' tom iii, p. 250.)

As a variety of the antero-posterior flaps the surgeon may at times, by transfixion, make the posterior one first, and then taking between his fingers and thumb all the soft parts not included in the posterior flap, complete the operation either by passing the end of the knife beneath these tissues and cutting outwards, or by cutting from without inwards, as in the former case. This plan is most expeditious, and was one generally adopted by the late Mr. Morgan, of Guy's.

In some cases, two lateral flaps may be made by either transfixion or cutting from without inwards.

The Flap Operation.

The surgeon having decided upon the operation, and obtai
or of his friends to its performance, should see, unless time
mulation is removed by either a mild aperient or an enema a
beforehand, and that as good a meal as the patient can tak
before the time fixed for the operation. The meal should
with some stimulant, or, when solids are not acceptable, of
brandy; for, assuming that chloroform or some anæsthetic
essential, to guard against sickness, and to have the process
beforehand, since vomiting is more prone to take place with a
The part to be operated upon should be well washed previou
present, also shaved before the patient is placed upon the ope

All instruments and dressing appliances should be arrange
before the time of the operation, and a sufficient number of as
duties allotted to them.

Thus, on one tray there should be a tourniquet or elastic ba
and good torsion forceps to twist, or ligatures to tie the ve
sufficient length and size, with a bistoury or catlin to divide
bone forceps for the treatment of the bone; a tenaculum sh
take up vessels that have retracted; there should be also a
retractor. The torsion forceps I employ (Fig. 120) are as
to tie as for twisting.

On a second tray every appliance for the dressing of a stu
as suture needles armed with wax silk, wire, or carbolized
sufficient lengths and breadths; lint for pads or dressings, an
can for hot water to heat the strapping should not be omi
abundance, *clean* sponges supplied by the surgeon, well w
squeezed dry, and soft towels so arranged as to be always at th
the operation, must be provided.

With respect to assistants, one to give the anæsthetic is a n
he should be an expert to whom the surgeon can resign his
is trying and somewhat risky for the operator when otherwis
the anæsthetist. A second is wanted to hold the limb above
of the limb to be amputated; a third to hold the limb below
quently, to sponge and help to twist or tie the vessels; while a
in amputation of the thigh and leg to hand the instruments, s
required, &c. They should be placed as shown in Fig. 612.

The nurse should be near to take away and clean all spon
replace them with others, squeezed quite dry.

When the operation has to be performed by daylight the
the best light can be obtained, and when by candle-light,
made. A good operating lamp is of great use, as well as a ha
any one part.

The operating table should be narrow and steady, a kitche
best, and is always available. In hospitals, there ought alwa

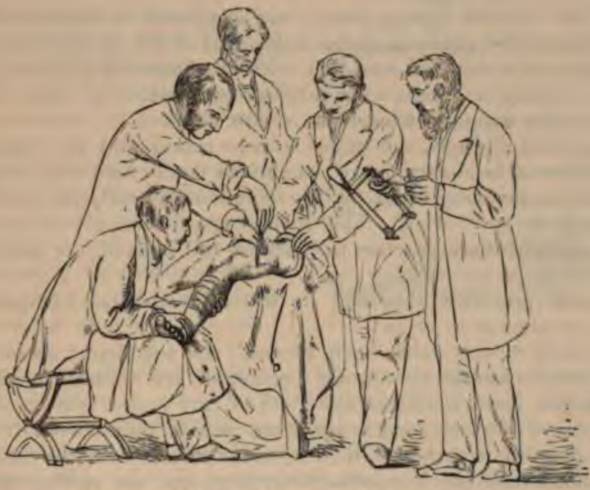
In amputation of the upper extremity the patient should b
the table, and in amputations of the lower extremity well do
being secured by a turn of a bandage or strap to the leg of th

In amputating, the surgeon should always stand on the *rig*
be amputated, in order to keep during the operation full cont
flaps, and possibly, of the main arteries, and afterwards of th
over, see that the tourniquet is so fixed as to control the ve
should on no account be done until the operation is about to
to be amputated should be emptied of its venous blood befor
raising its end for one or two minutes and smoothing with pr
upwards with the hand. The limb should then be constrict
or, Esmarch's elastic bandage.

In the flap operation now being considered (and for the sak
pose it to be a thigh) the surgeon should mark out with his
proposes to divide the bone, and, with his thumb on one side
the other, grasp it at a spot corresponding to the base of the

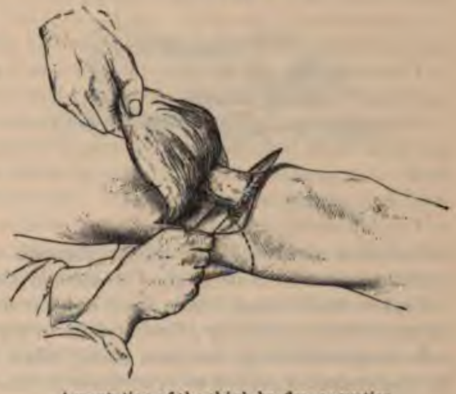
make, cutting from without inwards, taking care that the *base* of this flap is at least an inch lower down than the point at which the bone is to be divided. The anterior flap, which should be cut first and of skin, ought to be as long as the soft parts below will allow, and large enough to cover half the stump, or rather more than half the diameter of the limb, but when possible, it may be longer, since it is now generally admitted that the long anterior flap forms the best stump. The skin flap should be broad and cut square, with the angles rounded off, but not pointed. The muscles should then be divided down to the bone with a clean cut of the knife made from heel to point, and reflected with the skin flap. The anterior flap having thus been made, the point of the knife ought then to be passed through the wound beneath the bone, and the limb so transfixed as to include all the tissues that remained undivided. The knife should then be made to run downwards parallel to the bone, far enough to make a flap of the required length, and then turned backwards, the downward cut being made sharply (Fig. 613).

FIG. 612.



Surgeon and his assistants arranged for an amputation.

FIG. 613.



Amputation of the thigh by flap operation.

The surgeon during this stage of the operation should support with his left hand the under surface of the posterior flap. When the anterior flap has been only made of sufficient length to cover half the face of the stump, the posterior must be cut long to allow the two to meet. When the anterior flap has been a long one, two-thirds of the length required to cover the stump, the posterior flap need only be half the length of the anterior. Long flaps always yield the most satisfactory results.

When the flaps have been made, they should be carefully held away from the bone, which is to be bared upwards for about an inch above their base where it is to be divided, and two periosteal flaps cut and pressed upwards. The soft parts ought to be carefully held away from the bone to escape injury, and for this purpose, the linen retractor is of great value. The saw must then be applied, the bow saw (Fig. 612) being probably better than the flat. It should be used from heel to end with a firm, decided, yet free movement; too much pressure upon it being likely to cause splintering of the bone. During these steps of the operation, the assistant who holds the limb must be careful neither to elevate nor to depress it, for he will cause by the former act the surgeon's saw to become locked, and by the latter, splintering of the lower border of the bone. The best plan for the assistant to adopt is to apply extension to the limb in the axis of the bone to be divided, as if to draw the patient downwards, though not with sufficient force to effect this result.

When any splintering of the bone has taken place, the rough margin ought to be carefully smoothed down with the cutting forceps, care being observed not to tear away the periosteum.

Dr. McGill, of the United States Army, has suggested the propriety of making the periosteal flaps as described above to cover in the end of the divided bone in amputation, and gives three cases in which this was done with excellent effect (Circ. No. 3). I have adopted the plan on many occasions with satisfactory results; in some cases the end of the divided femur being capped with a mass of new bone.

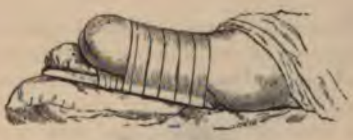
The bone being sawn through, the stump is to be raised and the main artery at once seized; the vessel should be drawn out of its sheath, firmly held with forceps (Fig. 120), and sharply twisted sufficiently often for the surgeon to feel that resistance has gone. The end ought not to be twisted off. The smaller arteries should be treated in the same way, it possibly being the best practice to twist off the ends of the small muscular and cutaneous branches.

When ligatures are preferred, they may be used, the carbolized catgut probably being the best.

As soon as the chief vessels have been secured, the tourniquet should be taken away and the stump elevated to assist the venous circulation, the assistant being ready with his finger to compress the main artery of the limb if any vessel remain unsecured. Any nerve trunks that have been cut long in the flaps should be removed to a level with the bone. A stream of iodine water may then be made to pass over the end of the stump to cleanse it of all blood and check capillary bleeding, and the surface dried with a soft towel, the surgeon satisfying himself that the vessels are all safely secured. The edges of the flaps may then be adjusted and kept in apposition by sutures, which must not be put in too closely, but inserted about half an inch from the margin of the wound, and made to perforate the skin and fat obliquely to the free border of the flap; the most dependent corner of the wound should be left open for the introduction of a drainage-tube.

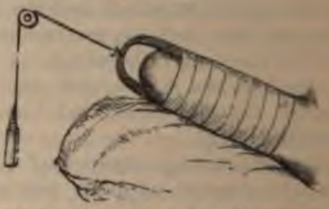
A posterior splint ought then to be fixed on the stump (Fig. 614), with pads of lint or sponge to maintain steady pressure upon the base of the flaps, though not on the wound, and a piece of dry lint or gauze, through which a hole has been cut for the end of the drainage-tube, is to be applied to the surface of the wound.

Fig. 614.



Thigh stump, with splint.

Fig. 615.



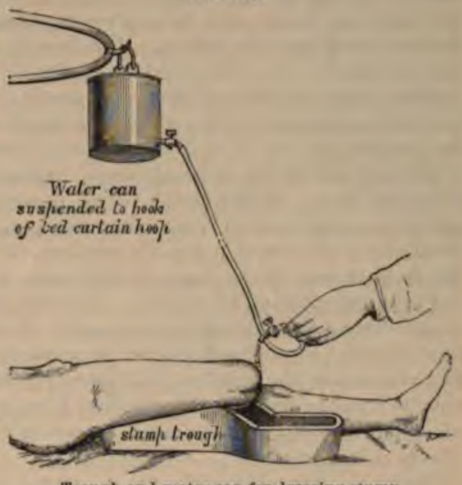
Thigh stump, with splint for extension.

Cotton-wool should then be bound over the stump, or a good large sponge, either of these materials forming a firm elastic compress which keeps the flaps well in apposition, and checks bleeding, due care being taken to keep the end of the drainage-tube exposed. To seal a wound completely, and not to leave a drainage opening must always be regarded as bad practice. With well-adjusted flaps, good drainage, and rest, as secured by the application of a splint, most stumps may be expected to do well.

The stump may be raised, as in Fig. 614, for the first day after the operation, but subsequently placed in a horizontal position. It should not be dressed for three or four days unless it becomes uncomfortable or the discharge offensive. for the less the parts are disturbed during the early days the better, repair going on much more satisfactorily when left alone than when the dressings are too frequently changed. To dress a stump, the trough, water-can, and tube, as illustrated in Fig. 616, are to be recommended.

When anything like retraction of the flaps exists, extension may be applied by means of a splint of perforated zinc, as seen in Fig. 615.

Fig. 616.



Trough and water-can for dressing stump.

Before chloroform was introduced, it was the late Mr. Aston Key's practice, as well as Mr. Syme's, to leave the stump open for a few hours before its flaps were brought together, and doubtless the measure was good, for in that time every bleeding vessel showed itself, and the surface of the wound became glazed, and, therefore, good for repair; but, since anæsthetics have been in use, this practice has fallen into desuetude, for the pain in the second dressing is always severe, and to give one for the purpose would be unadvisable.

The stitches may be taken away on the third or fourth day, when the parts should be supported by strapping if they gape, or if union is not solid; water or other dressing to the wound being then all that is required. Of late years I have used with advantage terebene mixed with olive oil, 1 part to 3.

Prof. Humphry, of Cambridge, many years ago, was so impressed with the evil attending the retention of serum or other fluids after amputation, that he was led to dispense with dressings altogether. He left the wound exposed, and allowed a scab to form over its surface. This practice has been followed by Dr. J. Wood, of New York, and other good surgeons since; and, although to my mind, it is not so satisfactory as pressure applied to the base of the stump, a free opening at its surface for drainage, perfect rest as enforced by use of a splint, and gentle support given to the whole by cotton wool, it is decidedly superior to the plan of covering the whole up with strapping and allowing no outlet for the escape of serum or other pent-up fluid. No one denies the evil influence of such fluids—*first*, in causing pain by the tension of the distended parts; and *secondly*, by incurring the risk of their decomposition, and subsequently of septicæmia.

In recent times, however, theories have sprung up which have originated new practices, and the most important is that on which the so-called antiseptic treatment of wounds is based. Lister is its chief advocate, and under the influence of his great authority it has established a position which deserves attention. The theory upon which the practice is based is one thing, but the practice is another.

At present, the germ theory is not established, although the practice based upon it has taken a hold on the professional mind in this and other countries, and has so much success to boast of, that its value, under certain conditions, cannot be disputed. How much of this success is due to the care observed by the surgeon who dresses the wound, and the close personal attention which any case so treated necessarily receives, and how much it depends upon the means employed for placing a wound as much as possible under the conditions of a subcutaneous injury is not yet determined. I am disposed to think, that this latter point is the more important, and that where the conditions can be fulfilled, the practice is to be recommended. The theory on which this practice is based, which I give in Lister's own words, is founded upon the labors of Pasteur, who believed he had proved "that putrefaction is not occasioned by the chemical action of oxygen or any other gas, but is a species of fermentation analogous to that of sugar under the influence of the growing yeast plant, being brought about by the development of microscopical organisms, the germs of which, from their extreme minuteness, float in abundance in the air as constituents of its dust. This being once clearly understood, it is plain that putrefaction in wounds may be avoided without excluding the air by dressing them with some agent capable of destroying the vitality of the atmospheric organisms, provided that it does not act with too great violence upon the human tissues. . . . Carbolic acid," adds Lister, "happened to be the first agent that I employed on this principle, and it still appears to be the most convenient for the purpose; it also has the advantage of being a local anæsthetic."

"In dealing with an accidental wound it is necessary first to kill any septic organisms introduced into it from the air or from contact with foreign bodies, and this is done by washing the cut surface thoroughly with a saturated watery solution (one of the acid to twenty of water); but even this is felt to be a somewhat uncertain process, because some mischievous particle, lurking in some interstice among the tissues, may possibly elude the action of the lotion, and subsequently propagate its kind and spread putrefactive fermentation throughout the wound. For it is important to bear in mind that the acid applied to the interior has no persistent antiseptic effect, but is speedily dissipated, being partly washed away by the discharge and partly absorbed into the circulation. When, however, the wound is made by the surgeon himself on a previously unbroken integument (as in amputation) he has it in his power to prevent putrefactive organisms from ever entering it alive by operating in an antiseptic atmosphere, in the form of a cloud of spray imbued with the acid. Richardson's spray apparatus, as suggested for ether, with a solution of acid one to forty, answering every purpose, while the sponges are rendered harmless by wringing them out of a watery solution, the fingers of the surgeon and his assistant having been dipped in the same, and the saw and other instruments smeared with oil containing a tenth part of the agent. The wound must be covered with a cloth dipped in the lotion during any periods of suspension of the spray, which should, with such exceptions, be continued throughout the entire process, including the securing of the vessels and the introduction of the stitches."—*Lister*. " For cases of compound fracture seen for the first time several hours after the accident I use a solution of one part of carbolic acid in five of spirit of wine, introducing it by means of a catheter and syringe."—*Lister*, ' Lancet,' March 13th, 1875.

Lister further advises the use of catgut ligatures or sutures, prepared by steeping them for about two months in an emulsion made by mixing one part of crystallized carbolic acid, deliquesced by means of water with five parts of olive oil, this emulsion being kept in a jar with a perforated diaphragm supported a little from the bottom of the jar, in order that the gut may rest upon it in the oil, the water subsiding. He says it is as safe as any ligature, superior to wire, and does not act as a foreign body in the wound, the ends being absorbed. He has never known secondary hemorrhage to follow its use. During the insertion of the sutures, the spray is to be employed.

"At the completion of the operation it remains to carry out the other division of the antiseptic treatment, viz., to apply such an external dressing as shall securely guard for the future against the penetration of septic fermentations from without.

" For this purpose the most convenient material I have yet arrived at is the antiseptic gauze, made by impregnating a cotton cloth of open texture with a mixture of carbolic acid one part, resin five parts, paraffin seven parts, in which the resin serves as a vehicle for the acid, while paraffin is added to prevent inconvenient adhesiveness."

" This dressing, while it absorbs discharge, holds the antiseptic securely lodged in its fibres, where it is retained by the insoluble resin, and it is to this circumstance that it owes its superiority over most other porous applications. It is wrapped round the stump in about eight layers, and during the first few days, while there is a copious effusion of serum, it is well to surround it with some impermeable tissue to prevent the discharge from passing directly outwards, and to compel it to travel along the whole extent of the antiseptic investment which should reach several inches up the stump. The most durable and reliable is a fine cotton cloth, with a thin layer of caoutchouc on one side, known in the shops as hat lining. The gauze is also extremely useful in the form of antiseptic bandages, whether to check a tendency to retraction of the soft parts of a stump, or, for securing and completing a dressing. If strapping is required, common adhesive plaster may be rendered antiseptic by dipping it for a second or two in a watery solution of the acid; and it is most convenient to have the lotion hot, so that the strap is warmed at the same time by its immersion. It can then be applied effectively under the spray, which should always be used in changing the dressings of a stump, till the wound has become superficial. The antiseptic atmosphere not only affords perfect security against the introduction of mischief, which it would otherwise be extremely difficult to avoid, but has the great advantage of permitting free inspection and manipulation of the stump. When the spray is intermitted, the wound must be covered with a "guard of rag dipped in the lotion. The ends of the adhesive straps should be overlapped by the gauze, to prevent them from subsequently conducting putrefaction inwards. While discharge is free, the dressings should be changed daily; but as it diminishes, the intervals may be increased, till when there are merely a few minims in twenty-four hours the gauze may be left undisturbed for a week together."

" Besides these antiseptic precautions, there are two other points essential to bear in mind in carrying out the treatment, viz., to provide for the due escape of serum, and to protect healing parts from the irritating influence of the antiseptic gauze. For the first purpose I have found it convenient to lay in the wound a strip of lint soaked with an oily solution of carbolic acid (1 to 10), one end hanging out as a drainer, this being removed on the second day of the operation under the spray. For the second purpose it is necessary to protect the cicatrizing part by interposing between it and the gauze a layer of oil-silk coated on both sides with copal varnish, and afterwards brushed over with dextrine to enable it to become uniformly moistened when dipped into a watery solution. It is thus immersed just before being laid upon the wound, the dressing of the wound consisting of an antiseptic to keep out putrefaction, and an unstimulating protective to exclude the antiseptic." "For lubricating instruments introduced into the bladder I use a solution of carbolic acid in olive oil, 1 part to 20." Lister uses also boracic acid in solution, or as lint, or ointment.

"This practice," writes Lister, "will be found by no means difficult or complicated. It requires no special skill, and the care which it is essential to take soon becomes habitual and instructive, and in the aggregate saves the surgeon a great deal of time, besides relieving him of a load of anxiety. For when a few days have passed without putrefaction, the dressings may be left unchanged for several days together, while at the same time the patient is felt to be absolutely secure against the various risks of pyæmia, erysipelas, hospital gangrene, necrosis, osteo-myelitis, or exhaustion from profuse suppuration."

"Surely," he adds, "these are advantages well worthy of our best efforts to attain them," and in this I cordially agree; but more experience is wanted before these advantages that Lister claims for it are established. I am no convert as yet to the theory on which it is based, nor to the great value of the special practice based upon it; neither is yet proved, and it is much to be regretted that the originator of the system should not have listened to the repeated requests of surgeons to publish the results of his practice as a whole, since it can be by such alone that the value of the method is to be estimated. The publication of isolated cases, however good, proves nothing, whereas the withholding of the whole suggests much. In Germany and in this country, the practice has made good progress, but it has suffered a little at the hands of its friends, for, when a German surgeon, in advocating a certain operation, states that "the justification of operations like these undoubtedly depends entirely on the possibility of *guaranteeing a successful termination*," and expresses his opinion that "we [the adopters of the antiseptic method] are not assuming too much in saying, that we have by degrees obtained sufficient practice and experience in the antiseptic treatment of wounds to be really able *to pronounce such a result with certainty*" ('Edin. Med. Jour.,' March, 1875), surgeons of a cooler temperament, who are not disciples of Lister's school, are startled; but, when they find such a cautious surgeon as Lister endorsing the observations, and adding to them, by saying that the passage I have quoted and he italicized "breathes the true spirit of earnest scientific surgery, and is remarkable for the modesty as for the confidence of its tone," surprise is exchanged for another feeling.

As an observer, who has no prejudice for or against the practice, I confess that I can neither recognize the modesty of the assertion nor the true spirit of scientific surgery it breathes; I can see in it the spirit of the advocate and the enthusiast, but not the calm mind of the judicial surgeon.

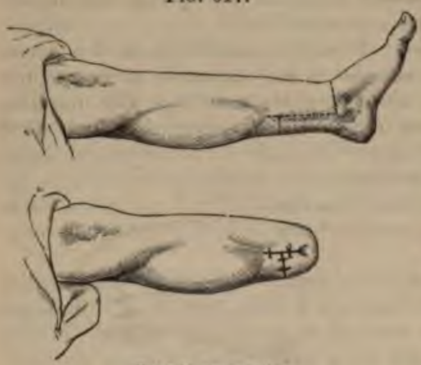
Surgery, however, is unquestionably indebted to Mr. Lister for the introduction of his system, since it has proved that closer personal attention to cases, and the observance of what were regarded as little things, are of great importance; but our knowledge of nature's processes of repair, although great, is not enough to justify any surgeon in guaranteeing any special result even in the simplest case; and the antiseptic treatment is not of such proved superiority as to justify any surgeon in claiming a control over its results, for that is what the power of guaranteeing means.

I have given the practice in the words of the distinguished originator, feeling that if it had no other influence to back it than Professor Lister's name and authority it ought to have a fair trial and be honestly tested.

The system may be good, and if so, will find its place in surgery, but over-confidence in its power will not help it. Like others, it will have to be judged by the true spirit of scientific surgery, and by that alone; but first let us have the facts.

Teale's amputation, a modification of the skin and muscular flap.—This was introduced "to procure a more useful stump, and in the hope of somewhat diminishing the mortality of the operation. It is proposed to amputate by a long and a short rectangular flap, the long flap folding over the end of the bone being formed of parts generally devoid of large bloodvessels and nerves, whilst those important

FIG. 617.



Teale's amputation.

structures are contained in the short flap. The size of the long flap is determined by the circumference of the limb at the place of amputation, its length and its breadth being each equal to half the circumference. The long flap is, therefore, a perfect square, and is long enough to fall easily over the end of the bone. In selecting the structures for its formation, such parts must be taken as do not contain the larger bloodvessels and nerves. A flap so formed will be, for the most part, anterior in position, as far as regards the general aspect of the body, but superior when the patient is in the recumbent position, as during the after-treatment. The short flap, containing the chief vessels and nerves, is, in length, one-fourth of the other (Fig. 617). The flaps being formed, the bone sawn, and the arteries tied or twisted, the long flap is folded over the end of the bone, and each of its free angles fixed by a suture to the corresponding free angle of the short flap. One or two more sutures may be required to complete the transverse line of union of the flaps, and to unite the side of the short to the corresponding portion of the long, as well as the reflected portions of the long flap to its unreflected. Thus the transverse line of union is bounded at each end by a short lateral line at right angles to it."

The surgeon should be careful in making this long anterior flap not to scarify it with his knife, more particularly when it is chiefly skin, as in the leg, since, on account of its length, it is very prone to slough, and if scarified this tendency is increased; indeed, this sloughing of the long flap is the great disadvantage of the operation, for in an ordinary thigh, twelve inches in circumference, a flap of six inches would have to be made. To secure a cicatrix away from the extremity of a stump is a point of great practical value, and to do so by a long anterior flap is, doubtless, an advantage; but this often requires more soft parts than are generally at the surgeon's disposal, unless more of the limb be taken away than requires removal. This object may, however, sometimes be secured by making a shorter anterior flap than Teale suggests, and dividing the bone one or two inches above the line of the skin flaps. In fact, as long as the anterior flap, whether rectangular or oval, is of sufficient length to be drawn over the end of the stump to its posterior aspect, the principle of Teale's operation is observed.

Mr. Spence, in his 'Surgery,' 1871, p. 749, tells us that he acted much upon this principle in 1858, making one long *anterior skin and muscular flap*, with a short posterior, clearing the bone for nearly two inches before dividing it.

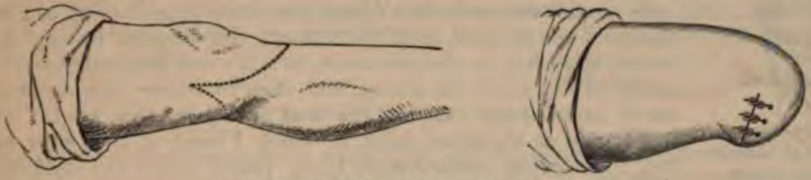
THE MIXED FORM OF AMPUTATION.

The mixed form of amputation, as illustrated by Carden's operation, will now claim attention. In principle, it includes a combination of the circular and flap, already described.

"The operation consists in reflecting a rounded or semi-oval flap of skin and fat from the front of the joint (knee), dividing everything else straight down to the bone, and sawing the bone slightly above the plane of the muscles, thus forming a flat-faced stump with a bonnet of integument to fall over it. The operation is simple. The operator, standing on the *right* side of the limb, seizes it between his left forefinger and thumb at the spot selected for the base of the flap, and enters the point of the knife close to his finger, bringing it round through skin and fat below the patella to the spot pressed by his thumb, then turning the edge downwards at a right angle with the line of the limb, he passes it through to the spot where it first entered, cutting outwards through everything behind the bone. The flap is then reflected, and the remainder of the soft parts divided straight down to the bone; the muscles are then slightly cleared upwards, and the saw is applied. Or the limb being held as before, the hand and knife may be brought round under the limb, as in the circular operation, and the blade entered near the thumb and drawn round to the opposite side, when the ham may be cut across by turning the edge of the knife upwards, and the operation completed as before. In amputating through the condyles the patella is drawn down by flexing the knee to a right angle before dividing the soft parts in front of the bone; or, if that be inconvenient, the patella may be reflected downwards." ('Brit. Med. Journal,' April, 1864.)

This operation of Mr. Carden's is very valuable, not only as applicable to the knee-joint to which it was originally applied, but on account of the principle of practice it embodies, that of making skin flaps and the circular division of the muscles. The practice, however, was not new, for when Mr. Carden began it in 1846, Mr. Syme had published in the 'Edin. Month. Journ. of Med. Science' of the same year, his modification of the circular method of amputation in the lower third of the thigh, by making two semilunar skin lateral flaps and oblique section of the muscles down to the bone, dissecting the skin flaps an inch or more upwards, and cutting the muscles on a level with the retracted skin. Liston also, in 1839, preferred skin flaps alone in muscular subjects.

FIG. 618.



Carden's amputation, with long posterior flap.

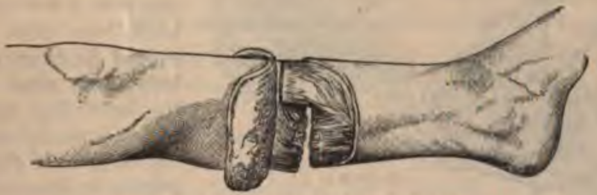
Accepting it as an operation for the removal of a limb through the condyles of the femur, I have, however, found it advisable to make a slightly longer posterior flap than Carden advises (*vide* fig. 618), making it only of skin, and taking care to make the long anterior flap broad, with a base corresponding to the posterior border of the lateral surface of the condyles.

In this operation, there is but a slight section of the muscular tissue, and beyond the popliteal artery, few vessels of importance are divided. The stump that remains is likewise remarkably good, being long and broad upon which patients can bear their weight without pain. This operation is, I believe, applicable to a far larger number of cases than is generally thought, and, with Lister, I look upon it as a great advance in surgery. It is, moreover, far safer than amputation through the shaft of the femur.

The object sought in all these long anterior flap operations is to procure a cicatrix that is placed behind the stump out of harm's way, and so long as this end can be secured without sacrificing more of the body than is absolutely required by the exigencies of the case the amputation is good; and it is a matter of small importance whether the rectangular and muscular flaps of Teale, the convex skin flaps of Carden, or the skin and muscle as practised by Spence, be employed. I prefer Carden's flap with the modifications described to any other, and, when applied to the knee, where it is most applicable, regard it with high favor.

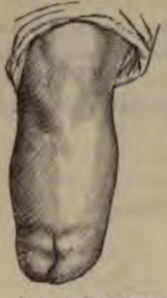
This "mixed method of amputation" has, however, a wider application than to operations about the knee; and, I believe it to be by far the best operation in all amputations of the leg and forearm. It combines the advantages of the circular and the flap without the disadvantages; and rarely, if ever, calls for the sacrifice of more of the extremity than is absolutely required. In its performance the two lateral skin flaps should be made sufficiently long to meet over the stump without stretching, the surgeon judging by his eye their required length, while the muscles should be divided by a circular sweep an inch below the base of the retracted flaps, the bones being bared to this extent before

FIG. 619.



Amputation of the leg by the mixed method.

FIG. 620.



Stump after an amputation of the leg by the mixed method.

they are divided (Fig. 619). Mr. Cock includes the muscles in the flap, but I hardly think this necessary unless the skin is very thin. When the flaps are brought together a pretty stump is seen, and subsequently it turns out to be a very good one (Fig. 620).

In amputation of the forearm, the mixed form is *the* operation, the skin flaps being made from the anterior and posterior aspects of the limb, the flap amputation executed by transfixion, being very unsatisfactory, on account of the tendons of the forearm (Fig. 625).

In amputation at the wrist-joint and elbow-joint nothing can be better than this mixed method (Figs. 623–4), the surgeon having it in his power, according to circumstances, to make one long anterior, posterior, or lateral flap cover the stump, and thus to secure the cicatrix being out of harm's way. One of the best stumps of this kind I ever obtained was at the elbow-joint, in which I made a long skin posterior flap, the cicatrix subsequently being placed above the condyles of the bone and in front (Fig. 624).

SPECIAL AMPUTATIONS.

The subject of amputations as a whole having been considered, I propose now to describe them in detail as applicable to different parts of the body, and begin with the upper extremity.

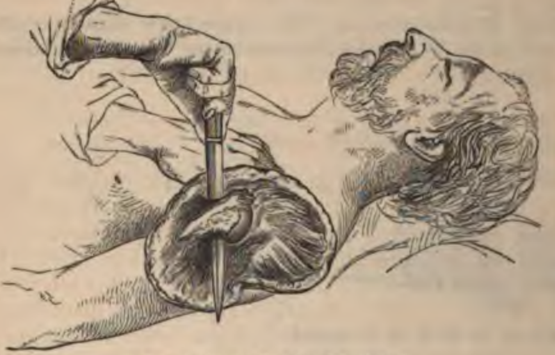
AMPUTATIONS AT THE SHOULDER-JOINT.

This operation may be called for in cases of injury, when the arm has been so irreparably injured as to render amputation through the tuberosities impossible or excision inapplicable; or for disease, when too extensive to be taken away by a less severe measure; the surgeon always bearing in mind that large portions of the humerus may be resected with advantage so long as the chief vessels and nerves of the arm are intact, and that amputation through the humerus, however high, leaves a far better stump than at the joint.

After this operation, when performed for injury, one out of three cases die; but when for disease, one in two.

The operation is best performed by means of the double flap operation. A good assistant is required to compress the subclavian artery above the clavicle, or to take charge of the axillary in the lower flap. When the right arm has to be amputated the surgeon should stand behind, and when the left in front of his patient (Fig. 621); under both circumstances a deltoid flap should be first made, cutting from without inwards from the posterior part of the axilla to an inch in front of the acromion process, this incision including in its sweep the whole deltoid muscle. Having reflected this flap with a few bold sweeps of the knife, the head of the humerus should be disarticulated, the knife being kept close to the bone, and the lower flap made, three or four inches long, by cutting from within outwards. If this part of the operation is done with care, the main artery of the limb will only be divided on the completion of the second flap, when the surgeon with his left hand can secure it between his finger and thumb until it can be either twisted or tied.

FIG. 621.



Amputation at the shoulder-joint.

During the first step of this amputation, the arm should be held well out by an assistant, but during the second, at first, near the body, and when the knife has passed beneath the head of the bone it should be abducted. A very good stump usually follows this operation. At no joint of the body, however, is the surgeon more compelled to form his flaps according to the circumstances of the case than at the shoulder, since the majority of cases of amputation at this part are for injury, where the arm has been wholly or partially torn off, when the surgeon must make the best flap he can, and at times no flap at all. As good a stump as I have made at this joint was one in which a piece of integument from the posterior part of the arm was alone available. I have seen many cases in which the flaps sloughed, and yet good cicatrices followed, the soft parts being readily drawn forward by the cicatricial process.

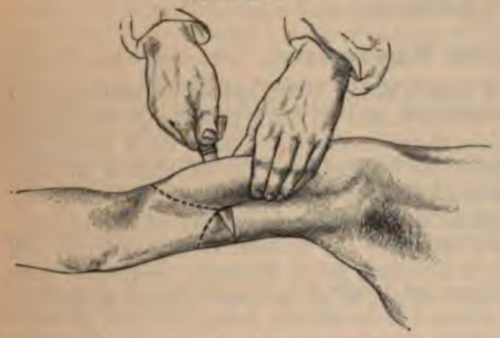
Some surgeons in this amputation prefer making an anterior and posterior flap, by perforating in front of the posterior axillary fold to make the posterior flap, disarticulating and dividing the axillary artery in the anterior flap; but the operation, although good, is not so efficient as the former.

Amputation at the Arm.

Excision of the elbow-joint, even when three or four inches of the humerus are taken away, is such a very successful operation that amputation at the arm is never called for when excision can be entertained, and this observation applies as forcibly to cases of injury of the elbow-joint, as seen in civil and military practice, as it does to cases of disease.

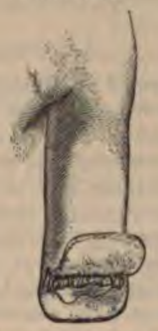
When, however, the forearm and elbow-joint are hopelessly injured, gangrenous, or diseased, amputation may be demanded, and, therefore, as the very worst cases are included in this category, the mortality of the operation is great, viz., one in three for injuries, and one in ten for diseases.

Fig. 622.



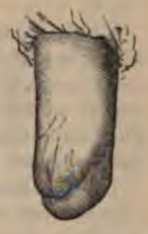
Amputation of arm by flap operation.

Fig. 623.



Amputation at elbow-joint by mixed method.

Fig. 624.



Stump after amputation at elbow-joint.

The flap operation, as already described, is the best in this region, the anterior flap being made by cutting from without inwards, towards the bone, excluding the brachial artery, and the posterior by transfixing all that remains. In a very large muscular arm, the skin flap and circular cut through muscle, *i.e.*, the *mixed* operation, may be performed. Amputating by double flaps and transfixion is, however, excellent (Fig. 622).

Amputation at the Elbow-joint

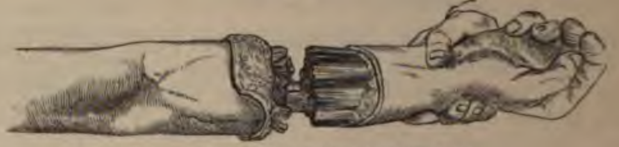
is a capital operation, and ought always to be performed in preference to any higher operation, when amputation of the forearm is imperative, if the condition of the soft parts will allow. By this operation an excellent stump is obtained, and, as in other amputations at joints, with less constitutional disturbance, and probably less risk to life than after other methods of amputation. I have had a patient up and about on the seventh day after such an operation, the wound having united without any traumatic fever or other disturbance.

It should be performed by the mixed method of amputating, by anterior and posterior skin semi-circular flaps, beginning and ending at the lower extremities of the condyloid ridges, the muscles being divided transversely on completing the disarticulation (Fig. 623). In the drawing of the stump (Fig. 624) the posterior flap was made longer than the anterior, in order that the cicatrix might be out of harm's way. I have performed this operation on six occasions, and the result in all was so good that I cannot too strongly advocate it whenever the injury or disease will allow; in fact, it ought to be performed whenever enough integument can be saved to cover the bone, and the disease or injury for which amputation is called for has not attacked the humerus.

AMPUTATION AT THE FOREARM.

This is comparatively a rare operation, modern surgeons doing their utmost to save the hand. It is consequently only performed when the hand is hopelessly crushed, or so extensively diseased as to forbid any other treatment being entertained. At Guy's Hospital it was performed only eighty-four times in thirty years ending 1874—on forty-four occasions for injury, nine patients dying, or one in five; and on forty occasions for disease with five deaths, or one case in eight, the operation being performed in the very worst cases. Amputation of the forearm ought always to be performed by the mixed method; the one by transfixing being very unsatisfactory, the many tendons, &c., of the part causing ragged flaps, and thus favoring suppuration. Two well-cut and fairly long semi-circular skin flaps and a clean circular section of the muscles are preferable to the flap operation, and yield a good stump (Fig. 625). The skin is usually too thin for one long skin flap, and there are too many tendons for a Teale's.

FIG. 625.



Amputation of forearm by mixed method.

AMPUTATION AT THE WRIST-JOINT.

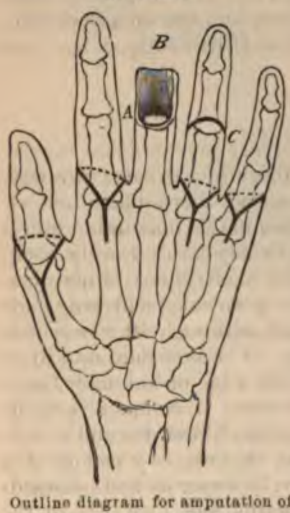
I have never performed this operation, nor seen it done; but I have seen two cases in which it had been performed years before for injury, and in both the stumps were constant sources of trouble to their owners during the winter months, from their being the seat of chilblains and ulcerations, on account of the feebleness of the circulation through the thin cutaneous covering, and in neither could a good hand be fitted with comfort. Both patients likewise regretted that the amputation had not been performed higher up.

Under these circumstances, I am disposed to follow the opinion of my patients, and cannot advocate the operation. If, however, it be called for, it should be performed with skin flaps and the circular division of the deeper tissues, or by the pure circular operation.

AMPUTATION OF THE THUMB AND FINGERS.

A knowledge of the shape of the articular ends of the bones and the position of the different articulations of the hand is of importance in all operations on these parts, and I have, therefore, supplied a figure to illustrate these points as much as possible (Fig. 626).

FIG. 626.



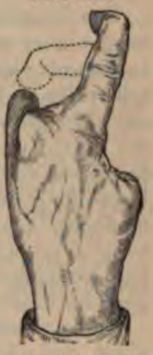
Outline diagram for amputation of the thumb and fingers.

The surgeon should remember, that with the hand closed, the knuckles are formed by the heads of the metacarpal bones, the bases of the phalanges being in front, and that in the second and third rows the same arrangement holds good. To open any of these joints, consequently, the line of incision should be anterior to the knuckles on the dorsal aspect and in the fold of the fingers on the palmar. In the figure it will be observed also that the two distal joints are concave, with the concavity looking towards the ends of the fingers, while at the metacarpal joints the concavity points the other way, the heads of the metacarpal bones being round; from the palmar surface the metacarpo-phalangeal joints are at least half an inch behind the clefts of the fingers, corresponding pretty nearly with the palmar furrow of the hand, this furrow likewise corresponds with the upper limit of the synovial sheaths of the flexor tendons and with the bifurcation of the digital arteries.

In amputating at the phalangeal joints (Fig. 626, C) or through the bones, anterior and posterior semicircular flaps are better than one long flap, although this may at times be performed with advantage, one long anterior flap (B), after opening the joint from its dorsal aspect (A) being the most common shape; but the surgeon must in these cases be much guided by what skin he has to utilize. As a rule, it is wise *not* to take off the head of the proximal bone, though when there is not sufficient flap to cover it the surgeon may be justified in removing its head with bone forceps.

Amputation of the fingers at their metacarpal joints requires much nicety, and in all the fingers the surgeon should remember, that he is on no account, unless absolutely required, to interfere with the palm of the hand; his incision in the palmar surface must never go beyond the fold of the joint. In performing this operation the surgeon is to take charge of the amputated member, an assistant holding the hand, separating the fingers, and compressing the radial and ulnar vessels. With the hand pronated, a vertical incision should be made about one inch long with a strong scalpel over the dorsal aspect of the head of the metacarpal bone, and from its distal end over the joint the knife should be made to pass up one cleft of the finger close to the bone to be removed, round the palmar surface of the finger in the fold, and through the second cleft to the point from which the circular incision started, the tendons and ligaments being divided as cleanly as possible (Fig. 626). The joint can then be opened and the finger removed. In a laboring man, it is wise *not* to remove the head of the metacarpal bone unless diseased, although in the higher classes it is sometimes expedient to take it away with bone forceps, to allow the neighboring fingers to be brought closer together, and thereby to improve the aspect of the hand. With the same object it is at times wise to take off the head of the metacarpal bone of the little or index finger obliquely, *i. e.*, in a direction sloping upwards away from the median line of the hand. In amputating either the little or index finger at this joint, the same form of incision may be made, the outer flap under both circumstances being somewhat larger than the inner, in order that the cicatrix may be placed close to the adjoining finger, and thus out of all harm's way. If the incision be made so as to allow the scar to fall over the exposed aspect of the hand, the result is very inconvenient, and often painful, as the hand naturally rests on its outer borders.

FIG. 627.



Hand after amputation of part of thumb, index, and two outer fingers.

The same arguments apply to the *amputation of the thumb*, one long external skin flap adjusted to a shorter flap in the cleft being far superior to the palmar and dorsal flaps usually adopted. But it may be here stated, that amputation of the thumb ought to be a very rare operation, as it is far better practice in all cases of injury to the thumb, where there is no possibility of saving it, simply to cut off any sharp point of bone, trim up the soft parts, and allow the stump to granulate, than to make what is sometimes called a good job of it by amputating the organ higher up; for any stump of a thumb, however short or ugly, is of use. In the hand here figured (Fig. 627) the man was an engineer, and he has been able for years to follow his occupation with but little inconvenience.

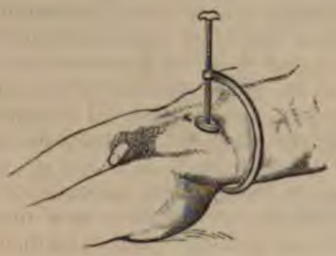
To describe other amputations of different parts of the hand is unnecessary. As little as possible should be taken away, and this by making skin flaps only, care being always observed to divide the tendons by a clean cut, and as high up as possible. The ingenuity of the surgeon and the wants of the individual case will suggest the best means by which the latter can be supplied.

AMPUTATIONS OF THE LOWER EXTREMITY.

These are of more importance than those of the upper, from their greater severity. There are, moreover, larger operations, more dangerous and possibly more difficult.

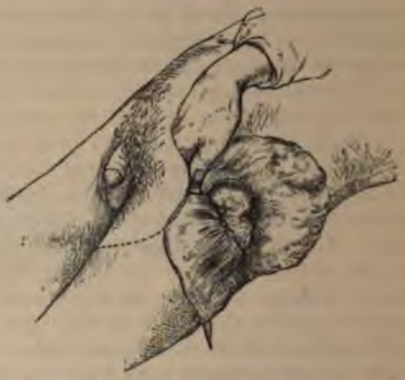
Amputation of the thigh at the hip-joint is a formidable operation, and is only justifiable under desperate conditions, when a limb is irreparably crushed or diseased, and resection of the head of the femur with more or less of its shaft is out of question. When performed for accident it is almost always fatal, not ten per cent. recovering; for disease, however, it is more successful, the risk being about equal, although after resection of the head of the femur which has failed it is somewhat better. The best flaps appear to be the external and internal. The patient being brought to the edge of the table, with the tuberosities of the ischium in view, Lister's valuable abdominal tourniquet is to be adjusted (Fig. 628), but not screwed up till the patient is under chloroform and everything prepared. The surgeon should then make the external skin flap by means of a semicircular incision, starting from the tuberosity of the ischium downwards and outwards one hand's breadth below the great trochanter, and then upwards and forwards to the centre of the groin (on the outer side of the femoral vessels). This flap should then be reflected upwards so as to expose the trochanter, and allow the joint to be opened, and disarticulation to be completed; the limb being forcibly abducted by an assistant to facilitate this step. In doing this, no vessels of any importance are divided, while the most difficult part of the operation is performed.

Fig. 628.



Lister's abdominal tourniquet.

Fig. 629.



Amputation at hip-joint by external and internal flaps.

The inner flap now remains to be made, which is readily done by transfixing the thigh on the inner side, inserting the knife (twelve inches long) in the anterior wound, passing backwards close to the inner side of the neck of the femur, and bringing it out near the tuberosity of the ischium where the external incision was commenced, and then cutting out through the soft parts, including the adductors, &c. (Fig. 629). In doing this, all the pelvic muscles are separated from the thigh bone at one clean sweep, and a few touches of the knife complete the amputation. Should there be much cause to fear loss of blood the common femoral artery may be ligatured in the wound before the second flap is made, or, it may be divided and twisted. The vessels can then be secured in the way the surgeon proposes, and the parts brought together, the two flaps usually forming an excellent covering to the acetabulum. The wound being an antero-posterior one, and therefore good for drainage, a good scar results.

This operation I believe to be better than the anterior and posterior flap usually advised, and which is thus described by Erichsen:—"If the operation be on the left side, the knife (twelve inches long) should be entered about two fingers' breadth below the anterior spine of the ilium, and carried deeply into the limb behind the vessels directly across the joint, its point being made to issue just above the tuberosity of the ischium. In transfixing on this side care must be taken not to wound the scrotum or the opposite thigh; the back of the knife must run parallel to, but not against, the pelvis, and the point must not be held too high, lest it enter the obturator foramen. The anterior flap must then be rapidly cut downwards and forwards about five inches in length. The limb must now be forcibly abducted and everted, the capsule of the joint opened. So soon as this is done, the head of the femur must be pushed up by forcibly depressing and abducting the limb, so that it may start out of the acetabulum; the heel of the knife is then passed behind it, the remainder of the capsule cut across, and the posterior flap rapidly fashioned by carrying the knife downwards and backwards through the thick muscles in this situation; the posterior flap may be about four inches long." The operation is then to be completed as the former. In both these operations good assistants are needed to compress the bleeding vessels as they are divided, for hemorrhage and the shock of the operation are the great evils to be feared. Lister's compressor, however, has rendered this serious operation safer than it was.

Amputation at the Thigh.

Primary amputations of the thigh, taken as a whole, are very serious, and calculating cases at all ages more than half die. In subjects under twenty years of age, however, better results can be recorded, the mortality being about half this amount; whilst in those over forty, the average is worse, age having here, as elsewhere, a striking influence on results. Primary amputations, however, in the upper third of the thigh are more fatal than those in the middle; and these again are more fatal than amputations above the knee, amputations through the condyles or at the knee-joint being better than all. The nearer the operation approaches the body the greater is the risk. Still, even in the worst cases of compound fracture of the thigh, when death seems inevitable, the surgeon should operate, when, by so doing, any reasonable hope of saving life can be entertained.

In amputations for diseases a better account can be given.

In amputation of the thigh for *chronic joint disease* at all ages, the mortality is about 1 in 4, but under the age of twenty, 1 in 17 ; while over that period it is 1 in 3, the difference in the mortality of the operation at the two periods being very great. Thus, taking all cases of chronic disease together, out of 89 of my own, 13 died ; of 99 of Callender's, 28 ; of 54 of Mac Cormac's ('Dublin Journal,' 1868), 10 ; and of 106 of Holmes's, 30 ; making a total of 348 cases, of which 81 died, or 1 in 4. In subjects under twenty years of age, out of 69 cases of Callender's and my own, 4 died, or 1 in 17 ; and of 119 cases over twenty years of age, 38 died, or 1 in 3 ; amputation of the thigh for chronic joint disease being nearly six times more successful in early than in middle life.

This operation in the upper or middle third, when the muscles are thick, is best performed by means of anterior and posterior skin flaps and the circular division of the muscle, or by the flap operation as illustrated in Fig. 613, the anterior flap being made by cutting from without inwards, and the posterior by perforating. The operation by lateral flaps, whether made of skin or muscle, or skin alone and circular muscle, is not satisfactory, the bones having a tendency to appear at the upper angles between the flaps. In amputation at the lower third one long anterior flap may be made, and a short posterior, as previously described under Carden's operation (Fig. 618).

Mr. W. Stokes, of Dublin, advocates ('Med.-Chir. Trans.,' 1870, 'Dublin Journ. of Med. Sci.,' 1875) the *supra-condyloid amputation* of the thigh, in which the femur is divided at least half an inch *above* the antero-superior edge of the condyloid cartilage, and the patella deprived of its cartilaginous surface is applied to the same surface, and fixed there with carbolized catgut sutures. The anterior skin flap is made oval, and the posterior fully one-third of the length of the anterior.

I have performed this operation in one case with a good result, and have seen it performed on several previous occasions by my colleagues with success. I think well of it, and would suggest a wider trial. My colleague, Mr. Jacobson, has written an interesting paper on it ('Guy's Hosp. Reps.,' 1878).

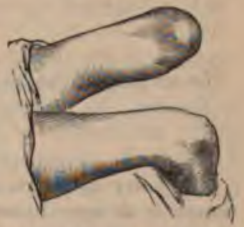
This operation differs from what is known as Gritti's in the section of the femur, being about one inch higher up.

AMPUTATION AT THE KNEE-JOINT.

This is an excellent operation in all ways, and one that should always be performed in preference to any higher amputation when the special circumstances of the case will allow. It is apparently attended with less risk to life than when a section of the bone is made, and yields an excellent and serviceable stump, on which the weight of the body can generally be sustained. Velpeau revived the operation in 1830, while Mr. Pollock recalled the attention of London surgeons to the subject ('Med.-Chir. Trans.,' 1870). In his paper he states, that up to 1870, 48 cases of the kind had taken place in England, and that 12 died, or one-fourth ; but since then the operation has been more common.

I have now performed it twenty-three times. On 7 occasions for compound fracture of the leg, 6 of which recovered ; in 13 cases for chronic disease of the knee-joint or leg, 11 of which recovered ; and in 3 cases for gangrene of the leg from arterial obstruction, one of which alone recovered, the operation in the other two having failed to save life.

Fig. 630.



Stump after amputation at the left knee-joint.

In only two or three of the cases did I remove the patella. In all the successful cases excellent stumps were obtained (Fig. 630).

In performing this operation, a long, broad, anterior flap should be made, which must of necessity be of skin, and also a tolerably long posterior, for it is remarkable to what an extent the posterior flap always retracts. I prefer to make my posterior flap about two-thirds the length of the anterior, and of skin only, and to divide the muscles and deeper structures by cutting from behind forwards for about an inch below the joint end of the tibia, and

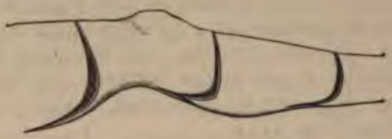
not after disarticulation ; the popliteal artery being thus div
readily secured. The patella should not be removed except

When the operation has been completed, and the articular s
not to be healthy, or reparable, or the flaps too short, the cond
a thin rounded section of bone being removed, or more if
demand. Dr. Brinton ('Philadelphia Med. Times,' 1872),
semilunar cartilages being left.

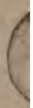
After the operation, a troublesome suppuration occasionally
bursa beneath the extensor muscles of the thigh, and when
with by free incisions.

Stephen Smith, of New York, has suggested ('Amer. Jour
the formation of two lateral skin flaps for this amputation, e
incision commencing one inch below the tubercle of the tibia,
forwards over the side of the leg (*vide* Fig. 631) until it reach
it is curved towards the median line. I have adopted this m

FIG. 631.



Stephen Smith's method of amputating.



Posteri
amputati

excellent results, and am disposed to think it the best. The
cicatrix being vertical and placed well behind the lower end

AMPUTATION AT THE LEG.

Amputation of the leg for disease is a very successful opera
twelve proving fatal. In young life it is more successful than

Amputations for injury are, however, very unsuccessful, at
than half the cases, dying. Pyæmia is a more common caus
amputation than even that of the thigh, it being fairly prove
of the shaft of a bone the greater the liability to blood-poison

Amputations of expediency in the leg are as dangerous as t

This operation in the upper two-thirds is, doubtless, be
method, by two skin lateral flaps and the circular division
decribed (Fig. 619). When the condition of the soft parts
other flaps may be made, any form being allowable to avoid
than is necessary. In the lower third of the leg, Teale's a
anterior flap not being too long or so liable to slough. The l
particularly the posterior calf flap, cannot be recommended.
Mr. Cock, who always includes the muscles and makes the fla
stumps. Some surgeons, in this mixed method, make anter
but they possess no advantage over the lateral; while the a
edge of the tibia, is apt to slough or to form unpleasant adhesi
its anterior edge should be rounded off with the saw.

AMPUTATIONS OF THE FOOT.

In no part of the body has an improvement in surgery show
in the foot, for in none has so much been done in the way of
merly amputation of the whole foot was common, we have
Pirogoff, the subastragaloid, and Hancock's operations, all bas
position that governs, or *ought to govern*, all amputations, vi
should be removed than the necessities of the individual case
upon the principle of "the least sacrifice of parts." To amp
less would suffice, in the present age, is regarded as almost

erally accept Hancock's well-put question, in his valuable lectures at the College in 1866, "Can anything be more unphilosophical than to advocate the sacrifice of any bone or joint of the foot for no other reason than that a particular operation should be performed?" ('Lancet,' 1866.) Indeed, this principle of practice should be uppermost in the mind of every surgeon called upon to treat any local disease, and in the hand and foot it should be so pre-eminently. Accepting it, therefore, Hancock's three other dicta necessarily follow.

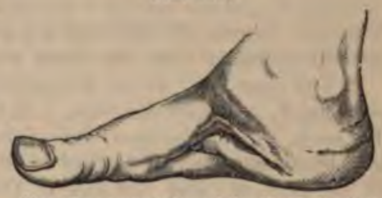
That we should perform our operation as close to the disease or damaged structure, and preserve as much of the foot as we possibly can do with safety to our patient.

That, where practicable, we should cut through the tarsal bones with a saw in preference to disarticulating them.

That we should avoid the destruction of parts whenever we can do so.

These views of Hancock accord so closely with those I have attempted to lay down as guides to the surgeon in the surgery of other parts of the body, that I have given them in his own words, and placed them as leading principles of practice in the surgery of the foot. I believe them to be of no less scientific than practical value, and desire that the student have them always before him in the treatment of every case of local injury or disease. Indeed, it is upon this principle—viz., "*the least possible sacrifice of parts*"—most of the operations of the foot are undertaken, and it is well to remember, that of the different amputations that have been recommended, each succeeding one is only a degree more severe than the preceding, and that none of them are called for until minor measures have altogether failed, as the surgeon in the present day takes away diseased bone or bones without fear, leaving nature to repair the breach, and in this confidence he is rarely deceived. I have taken away, in one case, the whole second row of tarsal bones, and in another, the three cuneiform, scaphoid and cuboid with excellent results. I have removed the necrosed os calcis with so little deformity that the loss could hardly be detected, and taken away on several occasions the upper articulating surface of the astragalus for disease, with a result which has astonished me, no external deformity remaining, and movement of the ankle being almost complete. Mr. Key in 1836 took away the whole of the outer part of the foot for injury, leaving only the os calcis, astragalus, scaphoid, inner cuneiform bone, and great toe (*vide* Fig. 633; 'Guy's Rep.,' 1836), from a boy, æt. 17, who subsequently had a useful and sound foot. More recently Mr. Birkett has done the same with a like success. Single metatarsal and tarsal bones when irreparably diseased may be removed with some confidence of a good result being obtained, and any of the operations I am about to describe should only be undertaken when less severe measures are inapplicable.

FIG. 633.



Foot after amputation of the four outer toes with their metatarsal bones, two external cuneiform and cuboid bones. Key's case. 'Guy's Hosp. Rep.' 1836.

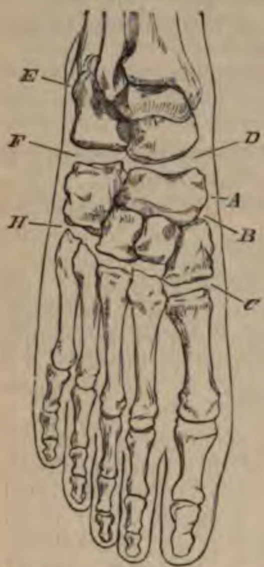
Upon this principle the amputations of Hey and of Lisfranc were hailed with satisfaction, Heys's consisting of the disarticulation of the metatarsal bones from the tarsal, or the section with the saw of the metatarsal or tarsal bones, Lisfranc suggesting the disarticulation. Chopart's amputation, again at the medio-tarsal joints, and Syme's amputation at the ankle-joint, Pirogoff's, which is a modification of Syme's, a part of the os calcis being preserved, have all the same end in view. The subastragaloid amputation, as recorded by Malgaigne, to save the astragalus and ankle-joint, is based upon the same principle, and Hancock's amputation to save the posterior part of the os calcis with the astragalus, goes still further in the way of conservatism.

All these operations have their own value, and each is applicable to its own class of cases; where the minor measure will suffice, the major is out of all question, the principle of the least possible sacrifice of parts being the one upon which they, as all other amputations, should be based.

Before considering the different forms of amputation it will be well to consider briefly the surgical guides to the foot as expressed by its anatomy, for although in cases of disease these guides are greatly obscured, they are still of value, and in cases of injury they are always reliable. The accompanying figure will help the student.

On the *inner* side of the foot, not far from the inner malleolus, the tubercle of the scaphoid (A) is to be felt as a marked prominence; about half an inch in *front* of this will be found the articulation with the cuneiform bone (B), and one inch beyond this the joint which the surgeon will have to open is Lisfranc's or Hey's operation (C); just above the

Fig. 634.



Surgical guides to foot as expressed by anatomy.

tubercle of the scaphoid will be found the articulation with the astragalus, the line of Chopart's amputation (D).

On the *outer* side of the foot, one inch below the external malleolus, a sharply defined projection will always be felt, which is the peroneal tubercle (E), and half an inch in front of this will be found the joint which separates the os calcis from the cuboid, this joint, forming the outer guide to Chopart's amputation. Half an inch in front of this again, or one inch from the tubercle, the prominence of the fifth metatarsal bone is always to be felt (H), the line above this prominence indicating the articulation with the cuboid bone, which forms the outer boundary of the incision for Hey's or Lisfranc's operation.

All these points should be looked for in the healthy foot, and learnt so as to be readily recognized in the injured or diseased.

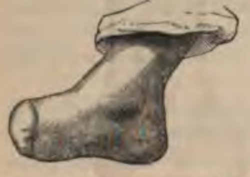
Hey's Amputation (Lisfranc's).

The credit of introducing this operation must be accorded to Hey, for the date of the first case he published was 1797, whereas Lisfranc's paper was only published as a suggestion in 1815.

The operation consists in the removal of all the toes with the metatarsal bones by disarticulation, although it seems, from reading Hey's observations (1814), that disarticulation of the metatarsal bones was not essential, since in one of the two cases recorded, the cuboid bone was removed with some part of the astragalus, and the second "the projecting part of the first cuneiform bone which supports the great toe was divided with a saw," and in others he stated, that he sawed through the metatarsal bones when the joints were not removed.

"The operator," writes Malgaigne, in describing it, "should use a small knife with a solid back, and only one edge. In operating on the right foot the patient should lie on his back, and the surgeon, facing the foot, should grasp it with his left hand, the thumb and finger respectively resting on the well-marked bony projection of the metatarsal bone of the little toe, and the base of that of the great toe placed one inch in front of the tubercle of the scaphoid. Half an inch in front of these points an incision with its convexity downwards is to be made across the dorsal aspect of the foot, dividing all the soft parts down to the bones by a second cut. The plantar flap is then to be made by two lateral incisions carried from the base of the dorsal flap along the metatarsal bones, and joined by a curved incision made on a line beyond the ball of the great toe. This flap is to be longer on the inner than on the outer side, because the internal cuneiform bone is thicker than the cuboid, and it is to include all the tissues down to the bones. Disarticulation has next to be performed, and this is best done from the dorsal region when the parts are put firmly on the stretch by depressing the toe. The operator then places the point of the knife on the outside of the joint and carrying its edge inwards he opens it as far as the third metatarsal bone. Around here he carries the knife half a line forwards, incises almost transversely, and thus reaches the second metatarsal. Here he must, above all things, remember the general precept, not to engage his knife in the joint, but to work only with its point, and to confine himself to the division of the ligaments. When this instrument has reached the second metatarsal bone, he quits this side of the articulation to attack the inner side. This is well done by inserting the knife between the shafts of the first and second metatarsal bones with its edge upwards, and with a backward and forward motion dividing the ligaments holding the second bone in place, this fact being indicated by the sudden loss of resistance which the surgeon feels when pressing the toes downwards, and by the sudden separation of the tarsus from the metatarsus. Disarticulation is then to be completed and the plantar flap shaped by cutting forwards close to the bone. A long dorsal flap may be made when the plantar flap must be short."

Fig. 635.



Stump after Hey's amputation. From Hey's work.

The parts are then to be brought together by sutures, after securing the vessels by torsion or the ligature and cutting off ragged tendons. The foot should be fixed upon a splint, with the leg semi-flexed upon its outer side, and treated on ordinary principles.

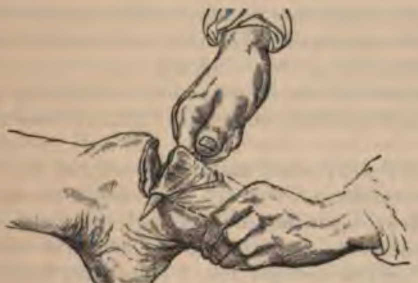
The stump left after this operation is good, and the operation one that ought to be performed when the toes and metatarsal bones alone require removal.

CHOPART'S AMPUTATION

is an excellent and valuable operation; and should always be performed in preference to any higher measure when disease or injury is confined to the fore part of the foot. The great theoretical objection brought against it—the subsequent drawing up of the heel and the consequent pointing of the stump—has really little weight, since it can be provided against by the division of the tendo Achillis at the time of the operation, or subsequently, should the difficulty occur. In many cases of my own, the tendons have never been divided. My colleague, Mr. Cock, who has performed this operation many times, thinks most highly of it, and never has had to amputate subsequently on account of the pointing of the stump. He believes that this can always be prevented or cured by the division of the tendo Achillis on the first indication of such a malformation. It was introduced into English practice in 1828, by the late Mr. James, of Exeter, and to the notice of Scotch surgeons by Professor Syme, who subsequently, however, renounced it in favor of his own operation at the ankle-joint. He did so on account of the objection already stated, and because in such partial amputations the part of the tarsus left behind, though apparently sound at the time, may become affected with the same disease at a later period. But such an argument may be brought against all operations less than the removal of a diseased part from the seat of mischief, and is now fairly repudiated by modern surgeons. In fact, all excisional and conservative surgery is based upon an opposite supposition, the local nature of disease becoming daily more acknowledged and acted upon.

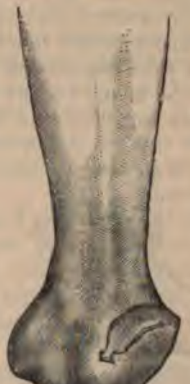
The operation may be described as the amputation of the fore part of the foot, anterior to the astragalus and os calcis, or as the medio-tarsal amputation. On the right foot it should be commenced by making a slightly convex flap from the dorsal aspect of the foot, commencing half an inch behind the prominence of the metatarsal bone of the little toe, and terminating at the tubercle of the scaphoid, the surgeon grasping the foot, with his index-finger on one point and his thumb on the other. The skin is the first part to be divided, and subsequently on the level of its retractions, all the tendons, &c., are cut through down to the bones or joints, the articulations are then opened, beginning at the scaphoid joint; the foot should be forcibly bent downwards to facilitate this part of the operation; the plantar flap is to be made by cutting forwards, and in doing this, care should be observed to keep the knife close to the bones on the sole of the foot, in order that the soft parts may be divided with as clean a cut as possible; the flap should be long and extend as far as the balls of the toes, the longer on its inner than outer aspect (Fig. 636). All ragged tendons may be cut off short, and the parts brought together. If there be any difficulty in bringing up the fore part of the stump, or any retraction of the heel, the tendo Achillis should be divided at once, but if no such difficulty is experienced, such

FIG. 636.



Chopart's amputation.

FIG. 637.



Stump after Chopart's amputation.

a measure is unnecessary. In dressing the stump, a good opening for drainage should be left. Fig. 637 illustrates the condition of the stump a year after the operation in which the tendo Achillis was not divided.

On one occasion, I performed this medio-tarsal operation for injury, making two lateral flaps from the dorsum and sides of the foot, the integument of the sole having been detroyed. A good stump resulted.

SUBASTRAGALOID AMPUTATION

follows next in order amongst the amputations of the foot, and is the removal of as much as is taken away in Chopart's amputation, with the addition of the os calcis. It should be performed when the disease for which an operation is required involves these parts, and yet leaves the astragalus and ankle-joint sound. It seems, according to Velpeau ('Operative Surgery,' 1839), to have been first performed by M. de Lignerolles, and subsequently by Textor, although Malgaigne in 1846 described the operation as his own without mentioning these facts.

It is made by a heel flap as in Syme's amputation, and a dorsal flap as in Chopart's, the foot being removed by opening the joints between the scaphoid and astragalus, and that between this latter bone and the calcis.

"The stump resulting from the subastragaloid amputation appears to me," writes Hancock, "to be perfect; it is round, and of good form; the cicatrix is firm, and well up in front, and the bottom of the stump is perfectly covered by the natural heel tissue." Nélaton says this form of amputation "has been found to surpass all amputations" ('Clin. Surg.').

Hancock's operation must be looked upon as a modification of the subastragaloid, in the same way as Pirogoff's is a modification of Syme's, for Hancock saves the tuberosity of the os calcis and turns it up to be united to the lower surface of the astragalus, from which he takes a slice of bone. It may be adopted, when in his attempt to perform the subastragaloid operation, the surgeon finds the lower surface of the astragalus diseased and the os calcis sound. Mr. Hancock performed it in 1864, with an excellent result. The incisions are very similar to those required in the subastragaloid, the end of the os calcis being divided in a line corresponding to the heel flap, instead of the flap being reflected. In the 'Lancet' for 1866, full particulars of Hancock's operation may be read, as described by him in a lecture at the College of Surgeons.

SYME'S OPERATION.

This consists in the removal of the whole foot with the articular surfaces of the bones of the leg just above the malleoli; a covering for the osseous surfaces being provided from the integument of the heel, the result being, adds Lister, "a stump admirably fitted for bearing the weight of the body. At the same time, the parts likely to originate carious disease are completely got rid of; so that this operation is calculated to supersede entirely that of Chopart, besides taking the place of amputation of the leg in the majority of cases formerly supposed to demand it" ('Holmes's Syst.,' vol. v, ed. 2).

This view of the operation which was also held by its originator, emanating from one who was so closely connected with Syme professionally and otherwise, is doubtless far too sanguine.

That the operation is good no surgeon will deny when amputation of the whole foot is called for; but to say that it will supersede entirely Chopart's operation is to say what I trust never will be true, for when the bones of the ankle-joint and the joint itself are sound, no surgeon ought to take away the whole foot if any minor measure will suffice. Where Chopart's amputation is applicable, Syme's ought not to be entertained. As an amputation of the foot, where the whole foot must be sacrificed, it is admirable; but, under no other circumstances can it be recommended; that it is superior to amputation of the leg most surgeons will admit, upon the same principle that Chopart's is superior to it, on the principle of the least possible sacrifice of parts.

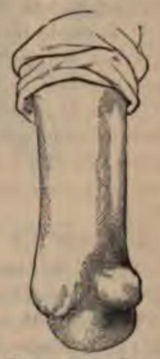
It is, however, a successful operation, Hancock reporting ('Lancet,' 1866) that out of 219 cases, only 17 died, or 7½ per cent.: 181 were operations for disease, and of these 11 died, or 6½ per cent.: 32 for accidents, of which 6 died, or 13 per cent. The experience of the American war speaks also in its favor, for out of 67 cases only 9 died, or 13½ per cent.

The operation is performed as follows. I give it in Syme's own words: "The foot being held at a right angle to the leg, the point of a common straight bistoury should be introduced immediately below the fibula, at the centre of its malleolar projection, and then carried across the integuments of the sole in a straight line to the same level on the opposite side. The operator having next placed the fingers of his left hand upon the heel, and inserted the point of the thumb into the incision, pushes in the knife with its blade parallel to the bone, and cuts close to the osseous surface, at the same time pressing the flap backwards until the tuberosity is fairly turned, when, joining the two extremities of the first incision by a transverse one across the instep, he opens the joint, and carrying his knife downwards on each side of the astragalus, divides the lateral ligaments so as to complete the disarticulation. Lastly, the knife is drawn round the extremities of the tibia and fibula, so as to expose them sufficiently for being grasped in the hand and removed by the saw. After the vessels have been tied (twisted). and before the edges of the wound are stitched together an opening should be made through the posterior part of the flap where it is thinnest, to afford a dependent drain for the matter, as there must always be too much blood retained in the cavity to permit of union by the first intention. The dressings should be made of the lightest description. That the flap may and probably will still occasionally slough is unhappily too true; but this result is always owing to an error in the mode of performance; for as the integument, being detached from its subjacent connections, can derive nourishment only from the anastomosing of vessels, it is evident that, if scored crossways, instead of being separated by cutting parallel to the surface, the flap must lose its vitality."

In Syme's first operation, in 1842 ('Observations in Clinical Surgery,' 1861), he simply took away the malleolar projections and did not remove the articulating surface of the tibia as subsequently advised, and it is still an open question whether any advantage is gained by this extra section of bone. I have performed this operation by Syme's original method, with an excellent result.

The stump following the amputation is excellent. Fig. 638, taken from Fergusson's lectures on the progress of surgery, illustrates it admirably:—"The very bit of soft material on which we naturally stand is still preserved for the future basis of this support."

FIG. 638.



Stump after Syme's amputation, from Fergusson.

Some surgeons, and Pirrie amongst them, perform the operation by sawing through the tibia and fibula without disarticulating the foot. The modification is good.

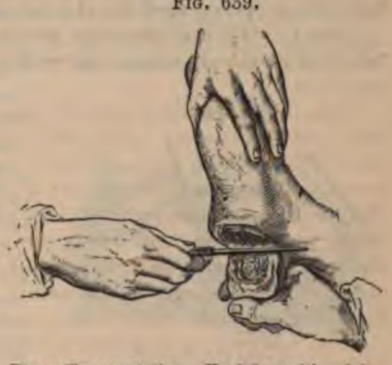
Roux's amputation differs from Syme's only in the flap being made from the inner and under side of the heel. I have on one occasion made a long anterior flap—the only one the condition of the parts permitted, with success.

PIROGOFF'S AMPUTATION.

This operation is to be regarded as a modification of Syme's, and was introduced by its distinguished originator during the Crimean war. The merit he claims for it is the novel osteo-plastic principle that, a portion of one bone remaining, naturally connected with soft parts, readily unites with another, and, at the same time serves to lengthen the limb and increase its utility. It differs from Syme's in leaving the tuberosity of the os calcis in the heel flap instead of dissecting it out, and bringing up its exposed cut surface to unite to the divided extremities of the tibia and fibula. I have frequently performed it, and in every instance with a good result. Busk was the first surgeon who did it in this country, in 1857.

The limb is longer than after Syme's amputation, and the stump is not to be excelled (Fig. 641), since a patient can walk upon it as well as if no amputation had been performed. The incisions are the same as in Syme's, but no heel flap is dissected up. After disarticulation and dividing the lateral ligament sufficiently far for the os calcis to become visible behind the astragalus, the surgeon has to saw through the os calcis in the line of the heel, and remove the foot, taking off, subsequently, the ends of the tibia and fibula.

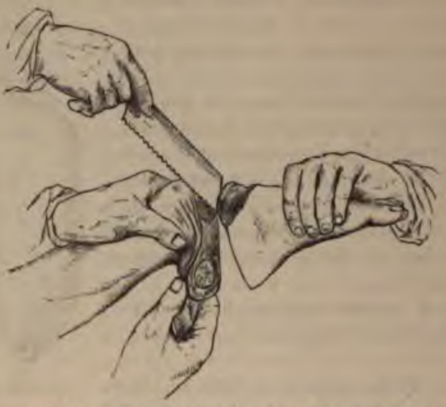
FIG. 639.



Pirogoff's amputation. Heel flap with calcis.

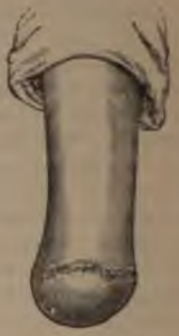
Dr. Eben Watson, after having made the heel flap, prefers before going further, to saw off as much of the os calcis as he wants to save; but there is an objection to this practice, as I have known the incision through the bone to be made too far forwards into the astragalo-calcanean joint, and a second slice have to be removed. Dr. Watson, also, adopts Pirrie's practice of dividing the tibia and fibula without previous disarticulation of the foot (Figs. 640 and 641).

Fig. 640.



Pirogoff's amputation. Division of malleoli. T. Smith.

Fig. 641.



Stump after Pirogoff's amputation.

When this method is employed, the surgeon should make a more oblique section of the os calcis from below backwards.

I regard Pirogoff's amputation as very good and it yields an excellent stump (Fig. 641); it ought always to be preferred to Syme's when the os calcis is sound. If the bone at the time of the operation be found to be bad it must be removed, the operation resolving itself into a Syme's; but when the bone is good, it appears to be a grave error to take away what makes so good a point of support to the body.

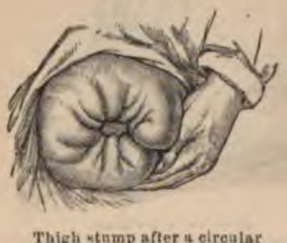
Hancock records fifty-eight cases of this operation as performed by British surgeons. Five only, or 9 per cent., died.

Amputation of the toes may be performed in the same way as amputation of the fingers already described, equal care being observed not to interfere with the plantar surface of the foot. In amputating the great or little toes the same oval flaps should be made as were recommended in amputation of the thumb and little finger (page 919). They should always be large and as much skin saved as the case will allow.

STUMPS, AND THEIR MORBID CONDITIONS.

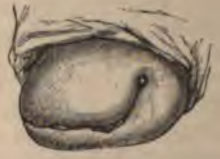
To secure a good stump is desirable, although to obtain it by taking away more of the body than is required by the exigence of the case, no increased risk to life should be incurred. Many of the most promising stumps after an amputation often turn out badly, while the least promising end well; the result depending more probably on their subsequent dressing than on the condition of the flaps at the time, it being quite certain that bad dressing may destroy the best stumps and good dressing improve the bad. Still, the character of the stump is much determined by the form of amputation that has been performed.

Fig. 642.



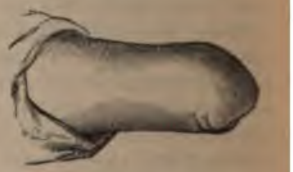
Thigh stump after a circular amputation of thigh.

Fig. 643.



After a flap.

Fig. 644.



Stump after amputation at the knee-joint.

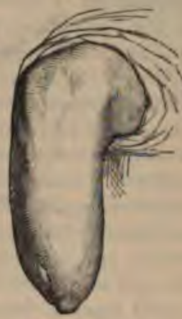
The stump after a circular amputation (Fig. 642) is not so good as that obtained after a flap (Fig. 643). The stump left after the mixed form of amputation of the leg, leaves nothing to be desired (Fig. 620), and that which is met with after amputation at the knee-joint when the patella is left is unexceptionable (Fig. 644).

A conical stump (Fig. 645) is always regarded as a bad one, and yet most thigh and arm (single bone) stumps after primary amputation become conical by time, the soft parts and muscles wasting, except in very fat subjects. When double bones exist, this evil is rarely seen, nor is it after amputations at the joints. Knee and elbow stumps and Pirogoff's are the best we see.

A stump that looks well after an operation, with a mass of muscle covering it, is sure to undergo a change; the muscles will degenerate and the muscular fibres losing all their characteristic features, turn into fibro-cellular tissue, of which, and of fatty tissue, a good stump is formed. The end of the bone will become rounded off, and its medullary canal filled up; the nerves of the stump also will become bulbous to a degree, but painful only when they are involved in the cutaneous cicatrix or bound down to the bone.

At times, however, stumps grow, and become conical, and in the amputations of childhood this condition must be expected. It is best seen in the leg, as it so happens that the shafts of bones grow most where they come in contract with the larger epiphyses, and in the leg, the one entering into the knee-joint is the larger. In the case of a boy, æt. 7, whose leg I had to amputate, with some irregular skin flap, for a compound fracture, just below the knee, I have had to take away on two occasions, at intervals of three years, two pieces of bone at least an inch long, purely from the growth of the bone during childhood, and it was interesting to notice, that the tibia on both occasions had grown at least twice as much as the fibula; in my second operation I never touched the fibula.

FIG. 645.

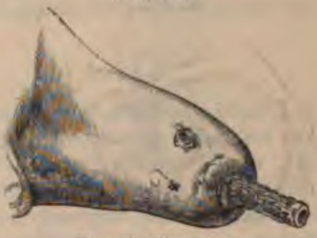


Conical stump.

Painful stumps are most distressing; and are commonly caused by some increase in the bulbous condition of the divided nerves, the nerve being included in the cicatrix or pressed upon by the bone, and under such circumstances, a cure is readily effected by the removal of the bulbous nerve. But in others, the extreme pain seems to be due to hyperæsthesia which is often called hysterical, the slightest touch of the end of the stump being sufficient to cause convulsive twitchings of the limb, and pain flying up the stump. In these cases, operative interference cannot be recommended, although nerve stretching has been advocated; the general condition of the body usually associated with this affection requires attention; tonics are always required, with local soothing anodyne applications, such as belladonna, opium, or stramonium ointments, &c.

Necrosis of the stump is a common condition, and is often due to too great a separation of the periosteum from the bone at the time of the operation from the forcible traction of the flaps backwards, and, at times, to a distinct endostitis of the divided bone (osteo-myelitis). In the former case, the necrosis is limited, and will probably show itself only as a ring of bone which may come away by itself or be removed. In the latter more or less of the shaft of the bone dies and subsequently exfoliates, the periosteum forming a new casing or sheath of bone to supply the dead bone's place, as in cases already described in the chapter on ostitis. The largest sequestrum I was ever called upon to remove from a stump, was from the femur of a man whose lower extremity I amputated for disease of the knee-joint consecutive to acute necrosis of the tibia. The femur became inflamed by endostitis after the amputation, and ended in endosteal necrosis. The sequestrum was five inches long. I drew it out of the end of the stump some months after the amputation, and an excellent stump was left. I have had also a similar case in a child about six years old—necrosis of the stump following amputation for acute necrosis of the tibia extending into the knee-joint. The stump united after the operation by primary union, but the bone subsequently appeared in the wound as a necrosed mass, this change being attended with slight constitutional disturbance. In exceptionable cases, the soft parts slip away from the bone and retract as a whole, the stump bone suddenly protruding through them for some inches

FIG. 646.



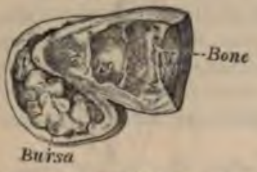
Necrosis of a stump.

(Fig. 646). In such the periosteum covering the bone becomes inflamed and with the soft parts dying loses its attachment and retracts. The bone deprived of its periosteum projects from between the flaps as a dead or dying portion, the result of periosteal necrosis. Under these circumstances the stump must be re-opened and the end of the bone removed high up.

Sir Joseph Fayrer tells us ('Clin. Surg.,' 1866) that in India, this osteo-myelitis of the ends of stumps is a common affection, and often attended with severe constitutional symptoms such as are well known to accompany all cases of acute *endostitis* with or without amputation. He regards the affection as so serious that he advocates the re-amputation of the limb above the next joint as soon as the earliest symptoms of systemic infection appear, blood-poisoning being the chief danger of the disease. "The proper time," he writes, "for amputation in cases of diffused osteo-myelitis is as soon as possible after you have ascertained that the bone is affected; and the mode of arriving at this knowledge is simply the passage of a long probe down the medulla. Should it impinge on healthy and bleeding medulla near the surface, you may, if the constitutional symptoms permit, wait and see if nature is about to limit the suppuration and throw off the diseased bone, which is a rare result. Should it pass well up the bone, its whole death is certain. In cases of incipient inflammation the medulla will be found protruding like a fungus from the central cavity, and the bone surrounding it exposed to a greater or lesser extent; at a later period the end of the medulla is found already dead, blackened, and encrusted, but within it is a putrid mass of bone, débris, and pus. In the former stage you can watch the progress of the case. In the latter interference is immediately necessary, and that I fear can be nothing short of amputation, either about the next joint, or perhaps in a young subject at the epiphysis. The condition of the soft parts must not deceive, the condition of the bone and the constitutional symptoms must be the guide as to the time and necessity for operations." I have made this long extract from Sir Joseph Fayrer's paper because it is through him, that in recent times the subject has been brought prominently under notice, though Longmore and Holmes in this country have ably dwelt upon it, and Roux, of Toulon, made it the subject of a special report.

In acute cases, there can be little doubt as to the wisdom of the practice suggested; but in English practice, they are not, however, of great frequency—the cases of necrosis of stumps met with being generally of a more chronic or subacute kind, of either periosteal or endosteal origin, and not requiring such active treatment.

FIG. 647.



Removed from John S—, æt. 16, who had had his arm amputated four years previously for an accident.

Aneurismal enlargement of the arteries of a stump has been described by Erichsen on Cadge's authority, and is an accidental association.

Cancer may also attack a stump. In December, 1871, I removed the leg stump of a man, æt. 58, for extensive cancerous disease of two years' standing, which attacked the cicatrix that had been formed fifty-four years (*vide* Fig. 25). In this case amputation of both legs had been performed for gangrene of the limb when the patient was a child four years old.

When the end of the bone in a stump is not well covered and is subjected to pressure, a bursa at times forms as a protective agent. This occurred in the case from which Fig. 647 was taken. I amputated the end of the humerus with the bursa, and a good stump was left.

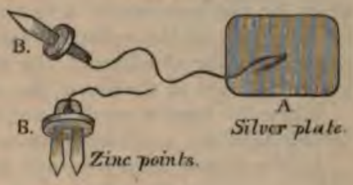
ELECTROLYTIC CAUSTIC.

I had intended to have introduced in a former page, a valuable electrolytic caustic which has been ably advocated by my friend and colleague Mr. C. H. Golding-Bird in the 'Lancet,' for September 28th, 1878, but omitted to do so. He applied it first for the removal of scrofulous lymphatic glands, but it is clearly applicable to other purposes.

The plan was originally suggested by the late Dr. Golding-Bird, Mr. Golding-Bird's father, as a painless method of forming issues under the name of the "electric moxa." In my dresser days it was occasionally employed to stimulate indolent and unhealthy sores, the silver plate being applied to the sore.

It acts on the principle of a Smee's battery, the salts in the serum acting as the sulphuric acid. A is a thin silver or copper plate about 2 to 3 inches square, and B points of metallic zinc 1½ inch long thrust through shields of cork or gutta-percha. The two are connected by very flexible copper wire. One or more zinc points may be used with the same silver plate. The silver is strapped firmly on to a piece of thick wash leather or lint, twice or thrice folded, soaked in strong salt and water, placed on the skin which is previously bathed with the same fluid. Oil silk over all keeps it moist many hours. The lint must be damped night and morning. The zinc is thrust into the gland to be destroyed, with or without a previous bistoury puncture and strapped in its place. After about five days, if the zinc is removed the gland is found destroyed, and converted into a gray friable mass, very acid to test paper. The best place for the silver is over the sternum; the wire with the zinc being brought beneath the collar to the neck. Unless suppuration is excited, which is very rare, there is no pain. With some slight modifications, this caustic can be used for keeping in check the growth of malignant diseases in parts, as the rectum or cervix uteri, where other operative means are inadmissible or unadvisable. "I have known," adds Golding-Bird, "of its employment in a case of the latter disease, where a rapid destruction of the growth and relief from pain was the result. A short rod of zinc was worn in the canal of the diseased cervix, and to it was attached a stiff copper wire insulated with gutta-percha, which terminated in a silver plate that was strapped to the front of the abdomen."

FIG. 648.

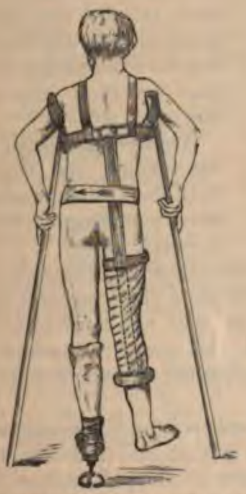


Thomas's Splints for Diseases of the Hip- and Knee-joints.

By some oversight these splints were not noticed in their right places, but they are too good to be omitted, the one for hip-disease being the only posterior splint we possess, and the other for knee disease answering admirably all the purposes of a splint, and permitting more freedom than any other.

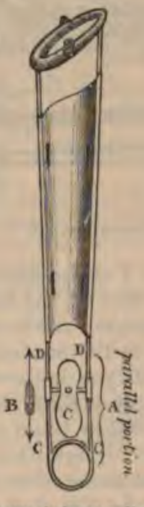
The *hip splint* consists of a long piece of malleable iron, one inch by a quarter for an adult, and three-quarters of an inch by three-sixteenths for children, extending from the lower angle of the shoulder-blade to the centre of the calf of the leg, to which an iron oval chest hoop, measuring four inches less than the chest circumference, is firmly riveted to the upper end, and two half hoops to support the thigh and calf, as seen in Fig. 649.

FIG. 649.



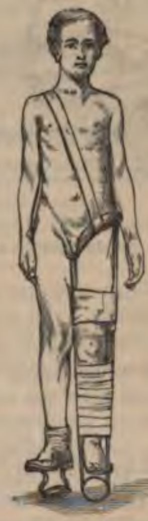
Thomas's posterior splint as applied for hip disease.

FIG. 650.



Thomas's knee-splint.

FIG. 651.



Knee-splint as applied to left limb, with patten on right.

The vertical iron band is carefully modelled to the outline of the trunk and limb, and the chest hoop fitted to the sound side, but away from the diseased. The whole should be well padded, and bound to the body passing in the direction of the sound side over the posterior surface; and if this is efficiently done the diseased limb will be well supported, and the patient, if a child, can be moved readily from room to room.

The curve of the instrument may require alteration from time to time, as the flexed limb becomes extended, and the curved spine straight.

The *knee-splint* is composed of a padded ovoid iron ring, three-eighths of an inch thick, to fit well up in the groin, and two vertical iron rods, ending in a patten about four inches below the foot, with an intermediate foot-piece (Fig. 650). An apron of basil leather is stretched between the iron bars for the affected limb to rest upon, in which slits are made for the insertion of a bandage to keep the limb and splint together. When the patient gets up the splint is suspended by a strap buckled to the ovoid thigh-ring, and passed over the shoulder of the sound side, and when he walks upon the splint a patten has to be fitted to the foot of the opposite limb, to maintain the level of the body, Fig. 651.

When the knee is much flexed a cushion or pad should be placed behind the knee which unfolds itself by a gradual process of extension.

As the disease improves, and the dependent position of the limb becomes allowable, the patient can get about by means of a patten on the opposite limb. The introduction of this patten for the above purposes is worthy of all praise.

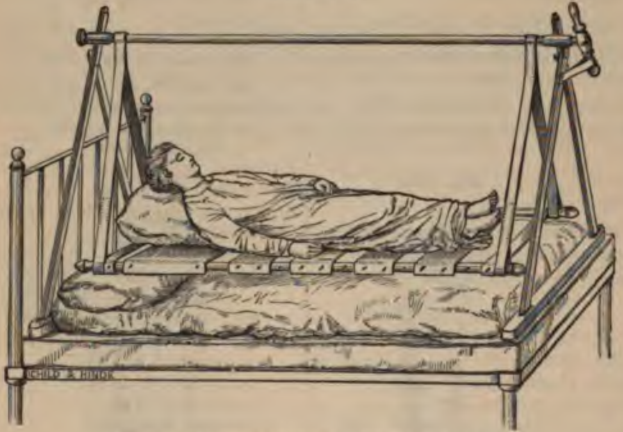
Invalid Lift.

This lift supplies a want. With it a patient can be raised from his bed with facility, and all dressing and nursing arrangements made without disturbing him. It can likewise be worked by an ordinary nurse, is portable and inexpensive.

First place the stretcher poles on the bed, one each side of the patient, the row of small iron pins outwards.

Pass one iron rod under the pillow, and turn the screwed end of it into the brass collar of the stretcher pole some five or six inches, putting the other end of the iron rod, which has a collar on it, into the opposite stretcher pole; then pass the other iron rod under the feet of the patient in the same manner.

FIG. 652.



Invalid lift as made at 237, Euston Road, N. W.

Pass the linen bands gently under the patient, where he is best able to bear pressure, the broad band under the shoulders and the two narrowest bands one at each end of the stretcher poles, at the same time placing the eyelet holes over the pins on each side of the stretcher poles.

Tighten the linen bands by turning the iron rods with the key, thus when necessary making the stretcher perfectly rigid.

Place the uprights marked No. 1 at the head of the bedstead, on the mattress or palliasse, with the number facing the foot of the bedstead; next place the iron shoe marked No. 1 on the square end of the upright; the handle end of the pole will now rest on the bedstead and support the uprights at the head till you put up the uprights marked No. 2 at the feet, with the number towards you in the same manner, when the whole will remain firm. Each lift is marked according to these instructions.

Place the remaining pieces of wood or bases at the head and foot (on the mattress when a feather bed is used), dropping the uprights into the holes cut in the bases to receive them. If the patient lies on the mattress, then place the bases on the palliasse, so that in either case the bed or mattress can be removed and shaken and the bed made comfortably whilst the patient is suspended above.

Slip the ends of the webbing attached to the long pole over the ends of the stretcher, put on the handle, and lift your patient gently by turning it to the right, and when up the required height, place the loop of webbing which is on your right hand securely over the end of the handle, when the patient will remain suspended. Take care not to let the handle slip while raising or lowering the patient.

INDEX.

- ABDOMEN, injuries of, 428
  - contusions of, 428
  - diagnosis in, 428
  - penetrating wounds of, 434
  - gunshot wounds of, 892
  - tapping, 455
- Abdominal parietes, wounds of, 434
- Abdominal viscera, wounds of, 434, 436
  - protrusion of, 435
- Abduction of leg in hip disease, 823
- Abnormal anus, 438
- Abscess, 30
  - chronic, 31
  - alveolar, 417
  - anal, 500
  - in bone, 860
  - in brain, 173
  - of breast, 680
  - fecal, 439
  - lumbar, 209
  - spinal, 209
  - perineal, 605, 614
  - of tongue, 376
  - of kidney, 552
  - of prostate, 565
  - of joints, 838
  - about joints, 855
  - opening, 31
  - Hilton's method, 32
- Abscess knife, 31
- Absorbent inflammation, 146
- Abscission, 275
- Accommodation, 225
  - diseases of, 226
- Acetabulum, fracture of, 794
  - impaction of femur in, 794
- Acromion, fracture of, 781
- Actual cautery, 308
- Acupressure, 305
- Acute internal strangulation, 443
- Adams's operation on hip, 833
  - for deformed nose, 518
  - for contracted fingers, 738
- Adduction of leg in hip disease, 824
- Adenitis, 146
- Adenoma, 95, 111
  - of breast, 685
  - cystic, 690
  - statistics of, 685
- Adhesion, primary, 23
  - secondary, 25
- Adhesions of iris, 240
  - of labia, 673
  - peritoneal, 707
- Adipose tumors, 91
- Air in veins, 359
- Air passages, foreign bodies in, 530
  - wounds of, 528
  - operations on, 536
- Albuminuria, 571
  - with shock, 189
- Alimentation rectal, 56
- Allarton's operation for stone, 597
- Alveolar abscess, 387, 417
- Amalgams, 414
- Amaurosis, 246
- Ametropia, 223
- Amputation in joint disease, 837
  - or excision of knee, 842
- Amputation, 902
  - in collapse, 190, 191
  - mortality of, 901
  - of the thigh for diseases of knee, 902
  - causes of death in, 905
  - different varieties of 906
  - instruments required in, 908
  - position of assistants in, 909
  - flap operation, 908
  - its history, 903
  - circular operation, 902
  - value of splints after, 910
  - Teale's, 913
  - Carden's, 914
  - mixed form, 914
  - at shoulder-joint, 916
  - of arm, 917
  - at elbow joint, 917
  - of forearm, 918
  - of thumb and fingers, 918
  - at wrist-joint, 918
  - at hip-joint, 840, 919
  - of thigh, 920
  - at knee-joint, 921
  - of leg, 915, 922
  - of foot, 722
  - in gangrene, 44
  - in gunshot injuries, 896
  - in compound fractures, 775
  - dressing stump after, 911
- Amussat's operation, 452
- Anal abscess, 500
- Anastomosis, aneurism by, 334
- Anæsthesia, local, 902
- Anæsthetics, action of, 896
  - rules for administration of, 898
  - value of, as aids to diagnosis, 900
  - improvements in practice due to, 900
  - in eye surgery, 251
- Anchylosis of spine, 210
  - of hip, 833
  - of knee, 836
- Anel's operation for aneurism, 327
- Aneurism, 316
  - diagnosis of, 319
  - diffused, 316
  - dissecting, 316
  - traumatic, 331
  - false, 316
  - true, 316
  - varicose, 332
  - rupture of, 319
  - spontaneous cure of, 318
  - by anastomosis, 334
  - fusiform, 316
  - arterio-venous, 332
  - cirsoid, 334
  - special, 338
  - treatment of, 320
  - by ligature, 327
  - by compression, 321
  - by manipulation, 329
  - by injection, 330
- Aneurism needle, 340
- Aneurismal varix, 332
- Aneurismal sac, relations of, to artery, 316
- Angeioleucitis, 146
- Animal poisons, 63
- Anatomical tubercle, 64
- Angular curvature of spine, 208
- Ankle-joint, dislocations of, 764
  - diseases of, 827, 837
  - suppuration of, 845
  - excision of, 845
  - amputation at, 928
- Annular stricture, 603
- Antiseptic ligature, 301, 912
- Antiseptic treatment of wounds, 911
- Antrum, diseases of, 389
  - dropsy of, 389
  - suppuration of, 389
- Antyllus, operation of, for aneurism, 329
- Anus, artificial, 452
  - abnormal anus, 438
  - imperforate, 493
  - diseases about, 497
  - fistula about, 500
  - painful ulcer of, 498
  - pruritus of, 510
- Aorta, abdominal aneurism of, 340
  - ligature of, 340
  - compression of, 340
- Aphasia after head injury, 165
- Arachnitis, 171
  - spinal, 198
- Arachnoid cysts, 168
- Aphthous stomatitis, 372

- Apnœa, 547
- Arch, palmar, wounds of, 351
- Arm, amputation of, 917
- Arrest of inflammation by obstruction of artery, 83
- Arrows, wounds from, 122
- Arteries, diseases of, 311
  - inflammation of, 311
  - atheroma of, 311
  - injuries of, 299
  - torsion of, 306
  - statistics of, 307
  - ligature of, 305, 327
  - general rules for the ligature of, 338
  - occlusion of, 300
  - subcutaneous rupture of, 300
  - hemorrhage from, 299
- Arteritis and atheroma, 311
- Arterial pyæmia, 58, 315
- Artery constrictor, 307
- Artificial anus, 452
- Artificial leech, 252
- Artificial pupil, 266
- Artificial respiration, 548
- Arthritis osteo., 853
- Articular ends of bones, disease of, 867
- Asphyxia, 547
- Aspirator in abscess, 31, 33
- Astragalo-calcanean joint, disease of, 828
  - dislocation of, 765
- Astragalus, dislocation of, 767
  - fracture of, 812
  - excision of, 845
- Atheroma, 311
- Atlas, disease of, 209
  - dislocation of, 202
- Atrophy of bone, 876
  - of muscle, 718
- Atropine in iritis, 240
- Aural polypi, 290
- Auricle, malformations of, 282
  - tumors of, 283
- Axillary artery, ligature of, 347

- BACK, injuries of, 196
  - sprains of, 205
- Base of skull, fractures of, 158
- Balanitis, 635
- Bandage, spica, 475
  - suspensory, 653
  - immovable, 776
- Barbadoes leg, 143
- Basedow's disease, 150
- Bath, calomel, 75
- Bavarian immovable flannel splint, 777
- Bedside experience, 19
- Bedsores, 40
- Bellocq's instrument for plugging nose, 519
- Bending of bones, 770
- Biceps tendon, rupture of, 716
- Bites, serpent, 65
- Bladder, diseases of, 536
  - rupture of, 433
  - irritable, 536
  - in women, 679
  - inflammation of, 558
  - sacculated, 559
  - washing out, 560
  - ulceration of, 560
- Bladder—
  - tumors of, 561
  - villous growths of, 562
  - cancer of, 563
  - atony of, 563
  - tubercular disease of, 563
  - paralysis of, 564, 621
  - stone in, 579
  - foreign bodies in, 602
  - malformations of, 630
  - gunshot wounds of, 893
  - on puncturing bladder, 624
- Bleeding, 364
  - in head injuries, 172, 175
  - in wound of lung, 542
- Blepharophymosis, 255
- 'Bloc, reduction en,' 477
- Blood poisoning, 53
  - prevention of, 60
- Blood tumors of scalp, 154
- Blood cysts in skull, 167
- Bodies, loose, in joints, 850
  - in bursæ, 722
  - in ganglion, 726, 852
- Boils, 134
  - Delhi, 138
- Bone, atrophy of, 876
  - abscess of, 860
  - contusions of, of skull, 156
  - diseases of, 856
  - inflammation of, 856
  - elongation of, from inflammation, 877
  - fractures of, 770
  - hypertrophy, 876
  - caries of, 568
  - necrosis of, 858, 864
  - sclerosis of, 858
  - tumors of, 869
  - diagnosis of, 875
  - pulsatile tumors of, 876
  - cysts in, 876
  - hydatids in, 876
  - cancer of, 873
  - amputation in, 875
- Bowel, internal strangulation of, 443
  - ruptured, 431
- Brachial artery, ligature of, 349
- Brain, bruised, 208
  - hemorrhage from, 163, 165
  - concussion of, 208
  - compression of, 168
  - hernia of, 171
  - inflammation of, 171
  - suppuration of, 171
  - wounds of, 170
- Brain and its membranes, injuries of, 165
- Brasdor's operation, 329
- Breast, diseases of, 679
  - Creighton's views of their pathology, 682
  - hypertrophy of, 686
  - engorgement of, 680
  - inflammation of, 680
  - abscess of, 680
  - sub-mammary abscess of, 682
  - chronic induration of, 682
  - the irritable, 683
  - tumors of, 682
  - adenoma of, 685
  - statistics of, 685
  - cancer of, 687
  - open cancer of, 692
- Breast—
  - statistics of, 689
  - colloid cancer of, 688
  - cystic disease of, 690
  - milk tumor of, 691
  - hydatids of, 692
  - nævus of, 692
  - retracted nipple in, 693
  - discharge from nipple in, 693
  - enlarged glands in, 694
  - infiltration of skin in, 694
  - chronic eczema of nipple preceding cancer, 693
  - excision of, 694
- Breast, tumors of, diagnosis of, 682
- Broad ligament, cysts of, 699
- Bronchocele, 151
- Bronchotomy, 537
- Bruise, 116
- Bubo, in clap, 635
  - in chancre, 639
  - in syphilis, 637
- Bubonocele, 481
- Bullets, varieties, 883
  - extractor, 887
- Bunion, 140
- Burns and scalds, 123
  - statistics of, 124
  - cause of death in, 124
  - pathology of, 124
  - of larynx, 533
- Burrowing of abscess, 30
- Bursæ, diseases of, 722
  - of synovial, 723
  - of popliteal, 724
  - acute inflammation of, 855
  - loose bodies in, 722

- CACHEXIA, 21
- Calcis, fractures of, 811
  - necrosis of, 867
- Calculus, nasal, 525
  - salivary, 373
  - in tonsil, 385
  - renal, 554, 574
  - prostatic, 569
  - vesical, 574
  - urethral, 579, 626
  - in female, 600
- Callisen's operation, 452
- Callous ulcers, 37
- Callus, provisional, 778
- Calomel bath in syphilis, 75
- Canaliculi, obstruction of, 256
- Cancer, 97, 111
  - scirrhous, 98
  - medullary, 99
  - melanotic, 101
  - osteoid, 109
  - epithelial, 101
  - colloid, 103
  - villous, 103
  - of lip, 369
  - of nose, 520, 523
  - of œsophagus, 424
  - of tongue, 377
  - of tonsil, 385
  - of rectum, 511
  - of bladder, 563
  - of prostate, 570
  - of penis, 629
  - of breast, 687
  - of testicle, 662

- Cancer—
  - of bone, 873
  - of scrotum, 669
  - causes of, 103
  - hereditary influence in, 104
  - treatment of, 104
  - by excision, 105
  - by caustics, 105
- Cancrum oris, 372
- Cannon balls, blows from, 884
- Carbolized ligatures, 301, 912
- Carbuncle, 134
  - facial, 136, 371
- Carcinoma, 97, 112
- Carden's amputation, 914
- Caries, 868
  - caustic treatment of, 869
- Carotid artery, compression of, 342
  - ligature of, 342
- Carpus, dislocation of, 754
  - diseases of, 849, 867
- Cartilage, diseases of, 817
  - dislocations of inter-articular, 763
  - tumors of, 93, 871
  - fracture of costal, 543
- Cartilages, sterno-costal, fracture of, 543
- Cartilages, loose in joints, 851
- Castration, 666
- Cataract, 267
  - operations for, 268
  - accidents during, 272
  - after treatment, 273
- Cataract glasses 273
- Catarrh of tympanum, 293
- Catarrhal conjunctivitis, 229
- Catgut ligature, carbolized, 301
  - preparation of, 912
- Catheter, on passing, 607
  - tying in, 607
  - Eustachian, 294
- Caustics, 105
- Cautery, actual, 308
  - galvanic, in fistula, 35
  - in piles, 506
  - in skin cancer, 105
  - in ovariotomy, 710
- Cell development, 23
- Cellular membranous sore, 35
- Cervix femoris, fracture of, 771, 795
- Cervical cysts, 87
- Cervical vertebræ, diseases of, 208, 212
- Chancre, 636
  - of lip, 371
  - infecting, 636
- Charbon, or malignant pustule, 137
- Cheloid tumors, 128
  - of ear, 284
- Cheiloplastic operations, 369
- Chest, injuries of, 540
  - gunshot injuries of, 891
  - wounds of, 543
  - of large vessels of, 298
- Chigoe, 145
- Chilblain, 133
- Children, hydrocele in, 641
  - irritable bladder in, 557
  - incontinence in, 564
  - stone in, 582
  - lithotomy in, 590
- Children—
  - retention in, 622
  - extravasation in, 626
- Chimney sweep's cancer, 101
- Chloroform, 896
  - value of, in strangulated hernia, 469
- Choked disk, 249
- Chopart's amputation, 924
- Chordee, 635
- Choroid, hyperæmia of, 241
  - injuries of, 242
- Choroiditis, 241
- Chronic intestinal obstruction, 445
- Cicatrices, diseases of, 127
  - division of, 127
  - congenital, 129
- Cicatricial stricture of urethra, 617
- Cicatrization, 24
- Circumcision, 628
- Cirsoid aneurism, 334
- Civiale's lithotrity, 586
- Clamp, for ovariotomy, 709
  - for piles, 506
- Clavicle, dislocation of, 744
  - fracture of, 781
- Claw-like extremities, 727
- Cleft palate, 379
- Clinical history, value of, 18
- Clitoridectomy, 674
- Clitoris, enlargement of, 674
  - cancer of, 673.
- Cloacæ in bone, 864
- Clots, "active and passive," in aneurism, 318
- Clover's lithotrity syringe, 554
- Clove-hitch, 750
- Club-foot, 729
- Coccygeal joint, disease of, 829
- Coccygeal tumors, 195
- Coccydynia, 829
- Cæcum, abscess about, 439
  - rupture of, 446
  - hernia of, 463
- Cock's operation for stricture, 612
- Cohnheim's views on inflammation, 24
- Cold as an anæsthetic, 902
- Cold ulcers, 39
- Coles's artery compressor, 323
- Collateral circulation, 332
- Collapse, 189
  - amputation in, 878
- Colles's fracture, 788
- Colloid cancer, 103
- Coloboma, 239
- Colon, rupture of, 431
- Colotomy, 452
  - for stricture, 448, 514
- Coma, 168
- Comminuted fractures, 814
- Compound fractures, 773–775
  - of skull, 159
- Compound dislocation, 744
  - of shoulder, 751
  - of elbow, 753
  - of knee, 763
  - of ankle, 765
- Compress, Dix's wire, 321
- Compression in aneurism, 321
- Compression of brain, 168
  - diagnosis of, 168
  - treatment of, 174
- Concussion of brain, 161
  - hemorrhage as result of, 163
  - treatment of, 174
  - remote effects of, 165
  - of spine, 196
- Condylomata, 510
- Congenital anomalies of eyelids, 227
  - of lips, 366
  - malformations, 727
  - hydrocele, 641
  - tumors, 194
  - cicatrices, 129
  - hernia, 480
  - syphilis, 77
  - sebaceous cysts, 89
- Conical cornea, 262
- Conjunctiva, disease of, 229
  - operations on, 258
  - injuries of, 232
- Conjunctivitis, varieties of, 229
- Constitutional sores, 36
- Contagious ophthalmia, 231
- Continuous suture, 119
- Contraction of bowel, 447
  - after strangulation, 469
  - of fingers, 737
- Contrecoup, 163
- Contusion, 116
  - of brain, 162
  - of scalp, 154
  - of chest, 540
  - of arteries, 300
- Convulsions in head injuries, 163, 171
- Coracoid process, fracture of, 783
- Cord, spermatic, varicocele of, 667
  - tumors of, 668
  - hydrocele of, 642
  - hæmatocele of, 649
- Cord, spinal, injuries of, 196
- Corns, 140
- Cornea, inflammation of, 234
  - ulcers of, 235
  - conical, 262
  - opacities of, 236
  - tinting, 263
  - wounds of, 236
  - burns of, 237
  - operations on, 262
  - foreign bodies in, 263
- Coronoid process of jaw, fracture of, 397
  - of ulna, fracture of, 790–791
- Cortical cataract, 267
- Cranium, contusion of, 156
  - fracture of, 157
  - compound of, 159
  - fracture of base of, 158
  - incomplete fracture of, 770
  - gunshot, injuries of, 888
- Crepitus of fracture, 773
  - in hip-joint cases, 795
- Cripps's splint, 802
- Croup, 536
- Curvature of spine, 206
  - Sayre's jacket in, 211
- Cutaneous cysts, 89
- Cut throat, 528
- Cutting teeth, 405
- Cyclitis, 242
- Cynanche tonsillaris, 384
- Cystic disease of breasts, 689
  - of testes, 660
  - of ovary, 696

Cystine calculus, 576
Cystitis, 558
Cysts, as tumors, 87
    dentigerous, 390, 403, 408
    thyroid, 88
    mucous, 88
    sublingual, 372
    sebaceous, 89
    tarsal, 252

DAVIES-COLLEY'S, talipes splint, 735
    operation for talipes equinovarus, 735
Deaf-mutism, 297
Deformities, 727
    heredity of, 728
    of nose, 518
    of chest, 545
Delhi boil, 138
Delirium tremens, 187
Dental caries, 412
Dental irritation, remote effects of, 410
Dental surgery, remarks on, 399
Dentigerous cysts, 390, 403, 408
    tumors, 390
Dentine, secondary, 411
Deposits, urinary, 570
Depressed fracture of skull, 157, 168
    trephining for 176
Dermal or dermoid cysts, 89
Diagnosis, 17
Diaphragm, rupture of, 434
Diaphragmatic hernia, 490
Diathesis, 20
    scrofulous, 20
    hemorrhagic, 20
Dieulafoy's aspirator, 33
Diffuse cellular inflammation, 49
Diffused aneurism, 316, 317
Digital compression of aneurism, 321
Dilatation of stricture, forcible, 608
Diphtheritic conjunctivitis, 232
Direct inguinal hernia, 481
Direct ophthalmoscopic examination, 219
Dislocation, 741
    of spine, 201
    of jaw, 396
    of ribs, 543
    reduction of old, 744
    compound, 744
    of clavicle, 744
    of scapula, 746
    of humerus, 746
    of elbow, 751
    of wrist, 754
    of carpal bones, 754
    of thumb and phalanges, 755
    of hip, 756
    of old dislocations of hip, 761
    treatment of, 759
    fracture and dislocation of, 762
    of patella, 762
    of knee-joint, 762
    of fibula, 763
    of foot at ankle, 764
    of astragalus, 767
Dislocation—
    of foot off astragalus, 764
    of tarsal joints, 766
    unreduced, 741
    reduction by manipulation of hip, 759
    of humerus, 748
Dislocation and fracture, 744
    of humerus, 751
    of hip, 756
Displaced hernia, 476
    reduction *en masse*, 477
    other varieties, 477
Displacement of femur in hip disease, 824
Dissecting aneurism, 316
Dissection wounds, 63
Distal ligature, 329
Dix's wire compress, 326
Dolbeau's perineal lithotrity, 598
Dorsalis pedis artery, ligature of, 355
Dorsum ilii, dislocation on, 757
Douche, nasal, 295, 518
Double splint for fracture of thigh, 799
    for hip disease, 832
Drainage tubes in abscess, 33
    after amputation, 910
Dropsy, diagnosis of ovarian, 696
Drowning, 547
    recovery from, 548
Dry gangrene, 42, 44
Duchenne's disease, 719
Dugas's guide to diagnosis of dislocation of humerus, 748
Duodenum, ulceration of, 124-5
    rupture of, 431
Dura mater, injuries of, 165
    inflammation of, after ostitis, 172
    blood outside, 166
    within, 167
Durham's tracheotomy canula, 539
Dysphagia, 423

EAR, external affections of, 282
    malformations of, 282
    cutaneous affections of, 283
    injuries of, 283
    tumors of, 283
    cheloid tumors, 284
    hæmatoma, 284
Ear, foreign bodies in, 286
    polypus in, 290
    bleeding from, in fractured skull, 160
Ear, middle, affections of, 285
    catarrh of, 293
Ear-ring holes, tumors of, 283
Ecchymosis, 117
Echinococcus, 145
Ectopion vesicæ, 631
Ectropion, 254
Eczematous ulcer, 39
Elastic extension, 799
Elastic ligature in fistula, 503
Elbow joint, amputation at, 899
    excision of, 848
    dislocation of, 751
    compound dislocations of, 753
    compound fractures into, 791
    diseases of, 829, 837
Electric indicators, 887
Electrolysis, in aneurism, 330
    in stone, 582
    in hydatid, 457
Electrolytic caustic, 930
Electro-puncture of aneurism, 330
Elephantiasis Arabum, 143
    ligature of main artery in, 144
    of scrotum, 668
    Græcorum, 143
Embolism, 313
    pulmonary, 314
    fat, in fracture, 773
Emigration of leucocytes, 28, 29
Emissions, nocturnal, 671
Emmetropia, 223
Emphysema, 542
Empyema, 545
Encephalitis after injury, 171
Encephalocele, 181
Encephaloid cancer, 100
Enchondromata, 93
    of bone, 871
    of jaw, 391
Encysted hernia, 481
    hydrocele, 645
Endostitis, 859
Enostosis, 526, 869
Enterocele, 461
Entero epiplocele, 461
Enterotomy, 450
    in malformations of rectum, 495
Entropion, 254
Enucleation of eyeball, 274
Epididymitis, 650
    in gonorrhœa, 635
Epigastrium, blows on, 429
Epiglottis, wounds of, 529
Epilepsy, trephining in, 183
    after injury, 176
Epiphysial cartilage, disease of, in hip disease, 823
Epiphysis, displacement of, of humerus, 753, 784
    of radial, 789
    of femur, 800, 804
    arrest of growth of bone from injury of, 877
Epiplocele, 461
Episcleritis, 237
Epispadias, 630
Epistaxis, 518
    in head injuries, 159
Epithelioma, 101
    of bone, 874
    of nose, 520-3
    of lips, 369
    of penis, 629
    of scrotum, 669
    of rectum, 511
    of tongue, 377
    of œsophagus, 424
Epulis, 386, 420
Equinia or glanders, 69
    mitis, 70
Erectile tumor, 334
Erysipelas, 47
    thermography of, 48
    phlegmonous, 49
    pathological appearances after, 50
Erythema, 53

Erythema—
  nodosum, 53
Esmarch's bandage, 304
  in aneurism, 324
  operation for closure of jaws, 395
Ether spray, 902
Eustachian catheter, passage of, 294
Excision of joints, 837
  of hip, 838
  of knee, 843
  of ankle, 845
  of shoulder, 846
  of elbow, 847
  of wrist, 847
  of larynx, 587
Exclusion, reasoning by, 19
Exfoliation of bone, 856
Exophthalmic bronchocele, 150
Exostosis, 869
  periosteal, 871
  cranial, 869
  of ungual phalanx, 143, 871
  statistics of, 871
  fracture of, 870
  of orbit, 279
  of meatus, 288
External meatus, examination of, 285
  affections of, 285
External piles, 503
External urethrotomy, 609, 610
Extravasation of blood, 116
  in fracture, 812
  of urine, 615
  of urine in children, 626
Extra-capsular fracture, 772
Extraction of cataract, 269
  after-treatment of, 273
  of teeth, 420
Extroversion of bladder, 631
Eye, injuries and diseases of, 216
Eyeball, examination of, 216
  operations on, 250
  position of patient in, 250
  rupture of, 282
  extirpation of, 274
  protrusion of, 275
  tumors of, 278, 280
  vascular protrusion of, 277
Eyelashes, malposition of, 253
Eyelids, diseases of, 227
  tumors of, 252
  injuries of, 228
  examination of, 216
  formation of new, 254

FACIAL artery, ligature of, 344
Facial carbuncle, 136
Facial nerve, paralysis of, 160
Fecal abscess, 439
Fecal fistula, 438, 468
Fecal impaction, 446
False joint, after dislocation, 741
  after fracture, 780
Farcy, 69
Fascia of palm, contraction of, 737
  Adams's operation for, 738
Fat embolism, in fracture, 773
Fatty tumor, 91
Fauces, ulceration of, 383
Feigned disease, 191
Female genital organs, affections of, 672
Female, stone in, 600
Femoral aneurism, 351
Femoral artery, ligature of, 352
Femoral hernia, 484
  diagnosis, 485
Femur, dislocations of head of, 756
  fractures of, 795
  of neck, 772, 795
  of shaft, 801
  of condyles, 804
  in children, 803
  compound, of, 804
  separation of epiphysis of head, 800
  of trochanter, 800
  of condyles, 804
  absorption of neck, 800
Fever, inflammatory, 27, 53
  hectic, 61
  traumatic, 53
Fibrin, excess of, in inflammation, 28
Fibro-cellular tumor, 92
Fibro-muscular tumor, 92
Fibro-plastic tumor, 92
Fibrous polypus of pharynx, 522
Fibrous tumors, 93
  of uterus, 712
Fibula, dislocation of head of, 763
  fracture of, 808
Fingers, compound fracture of, 793
  amputation of, 918
  contracted, 737
  dislocation of, 754
First intention, union by, 23
Fissure of anus, 498
Fissured palate, 379
Fistula, 34
  rectal, 500
  fecal, 438
  salivary, 374
  urinary, 622
  vaginal, 676
  vesico-intestinal, 561
Flap amputation, 908
Flat foot, 737
Flexion in aneurism, 325
  in reduction of dislocation of hip, 760
Fluctuation, 30
Follicular tumors, 90, 180
Foot, fractures of, 811
  dislocation of, 764
Forceps, artery, 304
  bone, 866
  bullet, 886
  lion, 392
  pharyngeal, 425
  tooth, 421
  tracheal, 533
Forcible taxis, 469
Forearm, amputation of, 918
  fractures of, 788
  compound, of, 792
Foreign bodies in conjunctiva, 233
  in ear, 286
  in nose, 521
  in pharynx and œsophagus, 425
  in air-passages, 530
Foreign bodies—
  in bladder, 602
  in rectum, 497
  in stomach and intestines, 439
  in gunshot injuries, 887
Fractures, 770
  incomplete, 770
  impacted, 771
  diagnosis of, 772
  prognosis, 773
  treatment of simple, 773
  in insane, 771
  of compound, 775
  from gunshot injuries, 907
  repair of, 778
  delayed union in, and ununited, 780
  deformity after, 780
  complicating joints, 775, 813
  extravasation in, 812
  comminution of bone in, 814
  spontaneous, 771
  fat-embolism in fracture, 773
Fractures, special, of jaws, 396
  of nose, 517
  of skull, 157
  of base of skull, 158
  compound, of skull, 159
  of spine, 201
  of larynx, 528
  of ribs, 541
  of clavicle, 781
  of scapula, 783
  of humerus, 784
  of radius and ulna, 788
  compound, of arm, 792
  from gunshot injuries, 894
  of metacarpal bones, 791
  of phalanges, 791
  compound, 792
  of lower extremity, statistics of, 794, 807
  of pelvis, 793
  of femur, 795, 800
  of leg, 807
  of patella, 805
  of foot, 811
  gunshot fractures, 894
  splints in, 775
  immovable splints, 776
  Colles's, 788
  Pott's, 764
Fracture with ruptured artery, 331
Fractured bed, 776
Fracture of exostoses, 870
Frontal sinus, diseases of, 525
  fracture of, 517
  enostosis of, 525, 870
Frostbite, 133
Fulminating glaucoma, 245
Fumigation, mercurial, 75
Fungus foot of India, 138
Furuncles of ear, 287
Fusiform aneurism, 316
Furunculus, or boil, 134
Fusible calculus, 577

GAG, 379
Galactocele, 691
Gall-bladder, rupture of, 433
Gall-duct, rupture of, 433
Galvanic cautery in fistula, 502

Galvanic cautery—
  in cancer, 106
  in nævus, 336
  in piles, 506
Galvano-puncture in aneurism, 330
Ganglion, 726
  diffused, 727
Gangrene, anæmic, 41
  static, 41
  traumatic, 41
  after ligature, 329
  hospital, 45
  senile, 42
  amputation in, 44
Gastrotomy and gastrostomy, 441
Genito-urinary organs, injuries and diseases of, 627
  malformations of, 630
  development of, 650
Genitals, female, affections of, 672
  wounds of, 672
  foreign bodies in, 672
  adherent labia, 672
  vulvitus, 673
  noma, 673
  labial cysts, &c., 673
  labial tumors, 673
  imperforate hymen, 674
  double vagina, 674
  vaginal tumors, 674
Genuflexion in popliteal aneurism, 121
Glanders, 69
Glands, inflammation of, 147
  in erysipelas, 50
Glandular tumors, 95
Glaucoma, 243
Gleet, 634
Glioma, 280
Glossitis, 376
Glottis, foreign bodies in, 530
  scalds of, 533
Gluteal aneurism, ligature of internal iliac in, 352
Goitre, 149
  exophthalmic, 150, 279
Gonorrhœa, 633
  in female, 634
  complications of, 635
Gordon's splint for fracture of radius, 790
Gouty phlebitis, 358
Grafting-skin, 129
Granular lids, 231
Granulations, 24
Gravel, 570
Green-stick fracture, 770
Gritti's amputation, 921
Gross's tracheal forceps, 533
Growth, arrest of, after fracture, 788
  after disease of hip, 825
Guinea-worm, 144
Gumboil, 418
Gum and chalk splint, 777
Gummata, 77
Gums, affections of, 386, 420
Gunpowder, burns from, 124
Gunshot injuries, 881
  shock in, 884
  hemorrhage in, 885
  of head, 888
  of chest, 891
Gunshot injury—
  of heart, 891
  of abdomen, 892
  of intestines, 892
  of bladder, 893
  fractures from, 893
  of upper extremity, 894
  of lower, 895
  amputation in, 896
Gustatory nerve, division of, 379

HARD cataract, 267
Hæmatocele, 648
  of the cord, 649
Hæmatoma auris, 284
Hæmaturia, 553
Hæmophilia, 20
Hæmostatics, 299
  surgical, 300
Hæmothorax, 545
Hemorrhage, 302
  secondary, 308
  summary of its treatment, 309
  urethral, 553
  vesical, 553
  renal, 553
  in gunshot wounds, 885
Hemorrhagic diathesis, 20
Hemorrhoids, 502
Hainsby's harelip truss, 368
Hammond's splint for fracture of jaw, 398
Hancock's operation on foot, 926
Hand, amputations of, 918
  dislocation of, 754
Hanging, 548
Harelip, 366
  suture, 117
Head, injuries of, 154
  general propositions on, 156
  trephining in, 176
  conclusions on, 179
  gunshot wounds of, 888
Headache after injury, 156
Heart, wounds of, 298
  gunshot wounds of, 891
Heat in inflammation, 26, 27
Hectic fever, 61
Hernia, diagrams of, 458
  abdominal, 460
  irreducible, 463
  obstructed, 464
  inflamed, 464
  strangulated, 466
  pathological changes in, 467
  treatment of, 469
  labial, 672
  multiple, 476
  displaced, 476
  inguinal, 480
  femoral, 484
  obturator, 486
  umbilical, 488
  other forms of, 490
  radical cure of, 483
Hernia cerebri, 171
  testis, 659
Hernial sac, 460, 481
  changes in, 461
  absence of, 461
  hydrocele of, 463
  reduction of, 477
  rupture of, 478
Herniotomy, 470
Herpes preputialis, 636
Hey's amputation, 924
Hilton's method of opening abscess, 32
Hip-joint, amputation at, 840, 919
  after gunshot injuries, 894
  disease of, 820
  diagnosis of, 822
  pathology of, 821
  treatment of, 831, 838
  suppuration of, 832
  removal of necrosed bone from, 838
  excision of, 838
  division of neck of femur in disease of, 833
  dislocation of, 756
  congenital malformation of, 769
Hodgen's suspension splint, 802
Hodgkin's disease of glands, 148
Holt's dilator, 608
Horns, 90
Hospital gangrene, 45
Housemaid's knee, 722
Howard's "direct method" of artificial respiration, 548
Humerus, dislocation of, 746
  statistics of, 746
  reduction of, 749
  unreduced dislocations of, 751
  fracture and dislocation of, 751
  compound dislocation of, 751
  fracture of, 784
  compound fracture of, 792
  impacted fracture of neck, 784
Hunterian chancre, 636
Hunter's operation for aneurism, 327
Hydatids, 145
  diagnosis of, 456
  of bone, 876
  of breast, 692
  of liver, 456
  tapping, 456
Hydrocele of hernial sac, 463
  of cord and testes, 640
  its pathology, 641
  congenital, 642
  encysted, 646
  radical cure of, 646
  on tapping, 645
  spontaneous disappearance of, 648
  of neck, 87
Hydrophobia, 66
Hydro-sarcocele, 654
Hydro-thorax, 545
Hydrops, antri, 389
  articuli, 826
Hymen, imperforate, 674
  rigid, 674
Hypermetropia as cause of squint, 259
Hypertrophy of extremities, 727
  of bone, 876
  of breast, 686
  of lips, 371
  of tongue, 375
Hypopyon, 235

Hypospadias, 631
Hysteria, 191
Hysterical retention of urine, 564

ICE in hernia, 464, 470
Ice poultice, 117
Ichthyosis linguæ, 376
Ileum, rupture of, 432
Iliac arteries, ligature of, 350
Ilio-femoral triangle, 797
Ilio-sciatic dislocations of hip, 757
Ilium, fracture of, 793
Immediate union, 23
Immovable apparatus in fracture, 776
Impacted fracture, 771
    of humerus, 784
    of radius, 788
    of neck of thigh-bone, 795
    of shaft of thigh-bone, 800
Impaction of feces, 515
Imperforate anus, 493
    hymen, 674
Impermeable stricture, 603
Impotence, 670
Incarcerated hernia, 464
Incision of membrana tympani, 293
Incomplete fracture, 770
Incontinence of urine, 564
Indirect ophthalmoscopic examination, 219
Indolent sores, 37
Infantile, hernia, 481
    hydrocele, 641
    paralysis, 718
    syphilis, 77
Inflammation, 26
    absorbent, 146
    asthenic, 28
    phenomena of, 26
    increase of temperature in, 27
    local effects of, 28
Inflammatory fever, 26, 53
Inflation of tympanum, 294
Ingrown toe-nail, 141
Inguinal hernia, 480
    direct and oblique, 481
    diagnosis of, 482
Inhaler, chloroform, 899
Innominate artery, ligature of, 341
Inoculation, syphilitic, 71, 73
    vaccino-syphilitic, 81
Insanity after head injury, 165
Insect stings, 64
Intention, union by first, 23
    by second, 24
Interarticular cartilages of knee, subluxation of, 763
Internal ear, diseases of, 291
Interrupted suture, 119
Interstitial keratitis, 234
Intestines, rupture of, 431
    protrusion of, 436
    obstruction of, 442
    on tapping, 455
    gunshot wounds of, 892
Intestinal obstruction, 442
    diagnosis of, 442
    causes of, 443
    acute, 443
Intestinal obstruction—
    chronic, 445
    from contractions, 447
    from stricture, 447
Intra-capsular fracture of femur, 772, 795
Intra-cranial suppuration, 171
Intra-parietal sac in hernia, 479
Intra-uterine fracture, 770
Intussusception, 448
    operative interference in, 449
Inversion of body in foreign body in air-passages, 532
    in intestinal obstruction, 450
Iridectomy, 264
    in glaucoma, 345
Irido-choroiditis, 241
Iridotomy, 266
Iris, congenital anomalies of, 239
    inflammation of, 239
    wounds of, 241
    coloboma of, 239
Iritis, 239
Irreducible hernia, 463
Irritable bladder, 57
    in women, 679
    mamma, 682
    ulcer, 38
Ischiatic hernia, 490
Ischio-rectal abscess, 500

JAW, deformities of, 395
    fracture of, 396
    treatment of, 397
    dislocation of, 396
    necrosis of, 387
    excision of, 388
    tumors of, 389, 391
    closure of, 395
Jejunum, rupture of, 431
Joints, contusions of, 739
    compound fracture into, 813
    dislocation of, 741
    diseases of, 814
    symptoms of, 819
    pathology of, 815
    treatment of, 830
    amputation and excision of, 837
    false, 741
    wounds of, 740
    neuralgia of, 192
    sprains of, 739
    anchylosis of, 824, 836
    loose cartilages in, 851
    acute suppuration round, 855
    necrosis of, 867
Jugular vein, wounds of, 356
    opening, 365

KELOID, 128
    of ear, 284
Keratits, 233
Key's lithotomy, 593
Kidneys, injuries of, 432, 550
    operations about, 555
    stone in, 554
    malformations of, 550
    abscess in, 551
Knee, amputation at, 921
    statistics of, 921
Knee—
    anchylosis of, 837
    diseases of, 826
    treatment of, 834
    mortality of amputation at, 921
    dislocation of, 762
    wounds of, 741
    suppuration of, 841
    excision of, 842
    operation of, 844
Knock-knee, 736
    Ogston's operation for, 787

LABIA, adhesion of, 672
    tumors of, 673
    hypertrophy of, 673
Labyrinth, affections of, 297
Lachrymal apparatus, disease of, 256
Lachrymal sac, washing out, 258
    obliteration of, 258
Lamellar cataract, 268
Laparotomy, 450
Laryngitis, 535
Laryngoscopy, 534
Laryngotomy, 537
Larynx, disease of, 534
    requiring tracheotomy, 534
    excision of, 537
    foreign bodies in, 530
    wounds of, 528
    tumors of, 536
    syphilitic disease of, 76, 536
    scalds of, 533
    fracture of, 528
Lateral curvature of spine, 206
Leech, artificial, 252
Leg, amputation of, 915, 922
    fracture of bones of, 807
    statistics of, 807
    compound, of, 811
Lens, affections of, 237
    wounds of, 238
    dislocation of, 238
    diseases of, 267
Leucocytes, 29
Leucorrhœa, 633
Lift, invalid, 932
Ligature, the action of, on artery, 301
    of catgut, 301
Ligature of arteries, 305
    mode of applying, 305
    carbolized catgut in, 912
    of abdominal aorta, 340
    of innominate, 341
    of carotids, 342
    of lingual, facial, 344
    of arteries of upper extremity, 345
    of iliac arteries, 350
    of arteries of lower extremity, 352
Lightning, accidents from, 126
Lime in eyes, 237
Linear extraction of cataract, 271
Lingual artery, ligature of, 344
    in cancer of tongue, 379
Lip, congenital fissures of, 366
    cancer of, 369
    chancre of, 371
    cysts of, 371

Lip—
  tumors of, 371
  nævus of, 371
  wounds of, 366
  restoration of, 369
  hare, 367
  phlegmonous inflammation of, 371
Lipoma, 91
  of conjunctiva, 258
  of nose, 520
Lisfranc's amputation, 923
Lister's mode of dressing wounds, 911
  tourniquet, 920
Lithic acid deposits, 572
  calculus, 575
Lithontriptics, 581
Lithotomy, 590
  when to be selected, 590
  causes of death after, 599
  sources of difficulty in, 596
  Key's operation, 593
  median, 597
  bilateral, 598
  Buchanan's, 598
  recto-vesical, 599
  high operation, 599
  in female, 600
Lithotomy and lithotrity compared, 582
Lithotrity, 584
  when to be selected, 582
  perineal, 598
Littre's operation, 495
Liver, hydatids in, 456
  ruptured, 430
Local anæsthetics, 902
Locked jaw, 183
Locomotor ataxy, 718
Lodgment of balls, 884
Loose cartilages, 851
  bodies in bursæ, 723
Lordosis, 206
  in malformation of hip, 769
  in hip disease, 824
  in rickets, 879
Lower jaw, removal of, 394
  tumors of, 393
Lumbar abscess, 209
  colotomy, 452
Lunatics, fractures in, 771
  fractured ribs in, 541
Lungs, condition of, in apnœa, 547
  after drowning, 548
  laceration of, 544
  wounds of, 543
  hernia of, 541
Lupus, 40
  of nose, 520
Lymphatics, affections of, 146
  wounds of, 149
Lymphoma, 115, 148
Lyssi in hydrophobia, 68

MACINTYRE'S SPLINT, 810
  Malformations, 727
  of anus, 493
  of ear, 282
  of genitals, 630
  of hip, 769
  of kidney, 550
  of feet, 729
Malignant pustule, 137
  tumors, 97
Mamma, diseases of, 679
  excision of, 694
Manipulation, treatment of aneurism by, 329
  reduction of dislocation of humerus by, 749
  of hip, 769
Marriage after syphilis, 80
'Masse, reduction en,' 477
Meatus, external, affections of, 285
Median lithotomy, 597
Medio-tarsal disease, 828
Medullary cancer, 99
Meibomian glands, obstruction of, 227
Melanosis, 101
  of eyeball, 281
Membrana tympani, injury to, 291
  examination of, 291
  perforation of, 292
Meningeal artery, rupture of, 166
Meningocele, 181
Metatarsal bones, amputation through, 924
Microscopical anatomy of tumors, 106
Milk cysts, 691
Mixed calculus, 576
Moles, 139
Mollities osseum, 877
Molluscous tumors of meatus, 289
Mortification, 41
Mucous cysts, 88
  of lips, 371
  of tongue, 88, 372
Mulberry calculus, 576
Mumps, 374
  orchitis in, 654
Muscles, injuries of, 713
  tumors of, 719
  vascular tumors of, 720
  rupture of, 713
  compound laceration of, 714
  dislocation of, 715
  degeneration of, 719
  of pectoral, 541
  inflammation of, 716
  of sterno-mastoid, 717
  division of, 738
  atrophy of, 718
  rigid atrophy of, 738
  ossification of, 719
  hydatids in, 719
  trichinæ in, 719
Mycetoma, 138
Myeloid tumor, 94, 873
Myopia, 223
Myxoma, 111

NÆVUS, 335
  of scalp, 181
Nails, affections of, 141
Nasal douche, 296, 518
Naso-pharyngeal polypus, 522
Nasal duct probing, 257
Neck of femur, fracture of, 771, 795
  of humerus, fracture of, 784
  of scapula, fracture of, 783

Onychia, 142
  maligna, 142
Operative interference in joint disease, 837
Opisthotonos, 183
Ophthalmia, varieties of, 230
  sympathetic, 243
Ophthalmitis, 281
Ophthalmoscope, examination by, 218
Optic disk, anomalies of, 221
Optic nerve, atrophy of, 249
Optic neuritis, 249
Orbit, affections of, 275
  tumors of, 279
  hemorrhage into, 277
Orchitis, 653
  chronic, 654
  syphilitic, 655
  tubercular, 657
Oriental sore, 138
Orthopædic surgery, 729
Osteitis deformans, 880
Osteo arthritis, 853
Osteo-chondroma, 872
Osteo-malacia, 877
Osteo-myelitis, 859
  after amputation, 930
  after gunshot injuries, 894
Osteo-sarcoma, 872
Osteoid cancer, 874
Osteotomy, for badly united fracture, 781
  in hip-joint disease, 834
Ostitis, 856
  of cranium, 182
Otitis, 289
  media, 296
Ovarian dropsy, 695
  diagnosis of, 696
  tapping, diagnostic value of, 698
  pathology of, 695
  statistics of, 695
  tapping in, 699
  treatment of, 699
Ovariotomy, selection of cases, 700
  operation, 703
  adhesions in, 707
  treatment of pedicle, 708
  on sponging out pelvis, 711
  treatment of wound, 711
  after-treatment, 711
Ovarian cysts, suppurating, treatment of, 712
Oxalate of lime, as gravel, 572
  as calculus, 576
Ozæna, 524

PAIN in inflammation, 27
  Painful subcutaneous tumor, 215
Palate, cleft, 379
  tumors of, 383
  wounds of, 382
  ulcerations of, 383
Palmar arch, wounds of, 850
Pannus, 230
Papillary tumors, 95
Paracentesis abdominis, 455
  thoracis, 545
  of joints, 835
  in ovarian dropsy, 699
Paralysis, result of concussion, 168
  spinal, 201, 203
  infantile, 718
  of bladder, 564, 622
Paraphimosis, 628
Parasites, 144
Parotid, inflammation of, 374
  tumor of, 374
Patella, dislocation of, 762
  fracture of, 805
  compound of, 807
  enlarged bursa over, 722
Pathological tubercle, 64
Pedicle in ovariotomy, treatment of, 708
Pelvic joints, diseases of, 828
Pelvis, fracture of, 793
  urethral laceration in, 793
  obstructed iliac artery in, 794
Penetrating wounds, of abdomen, 435
  chest, 543
  cranium, 159
Penis, amputation of, 629
  injuries of, 630
  cancer of, 629
  to fasten catheter in, 607
  warts on, 629
Perforating ulcer, of foot, 137
  of palate, 382
Perforating tumors of skull, 181
Pericardium, wounds of, 297
Perineal abscess, 605, 614
  lithotrity, 598
Perineal hernia, 490
  fistula, 616
  section, 612
Perineum, rupture of the female, 674
  operation for, 674
Perinephritis, 552
Periosteal exostosis, 871
  cancer, 874
Periosteal flaps in amputation, 875
Periosteum, acute inflammation of, 859
  chronic, 862
Periprostatic abscess, 566
Peritoneum, inflammation of, 429
  wounds of, 435
Peroneal tendons, dislocation of, 714
Phagedæna, 38
  venereal, 639
Phalangeal joints, diseases of, 830
  dislocations of, 755
  fracture of, 791
Pharyngeal abscess, 422, 535
Pharyngotomy, 427
Pharynx, affections of, 422
  foreign bodies in, 424
  wounds of, 425
  tumors of, 422, 523
Phimosis, 627
  with chancre, 639
Phlebitis, 357
  pyæmia and, 57
Phlebolithes, 362
Phlegmasia dolens, 857
Phegmonous erysipelas, 49
Phosphatic deposits, 572
  calculus, 577
Phosphorus disease of jaws, 387
Phrenic hernia, 490
Phthiriasis, 227
Pigeon-breast, 545
Piles, 503
Pinguiculæ, 258
Pirogoff's amputation, 927
  stump after, 928
Pituitary membrane, thickening of, 523
Plaster of Paris splints, 776
Plugging nostrils, 519
Pneumocele, 545
Pneumothorax, 546
Poisoned wounds, 63
Politzer's method of inflating tympanum, 283
Polypus of antrum, 390
  of bladder, 562, 679
  of ear, 290
  of larynx, 536
  of nose, 521
  of palate, 382
  of vagina, 674
  of rectum, 509
Popliteal artery, ligature of, 353
Position of lower extremity in hip disease, 823
Pott's fracture, 764
Poultice, ice, 117
Prepuce, operations on, 627
  tumor of, 630
Presbyopia, 238
Pressure to stop bleeding, 303
  in cure of aneurism, 321
Primary union, 23
Probang, 426
Projectiles, wounds caused by, 882
Prolapsus of rectum, 507
Proptosis oculi, 150, 277
Prostate gland, affections of, 565
  retention in, 622
  inflammation and suppuration of, 565
  hypertrophy of, 566
  calculi of, 569
  cancer of, 570
Pruritus ani, 510
Psoas abscess, 209
Psoriasis of nails, 142
Pseudo-hypertrophic paralysis, 719
Pterygium, 236, 258
Ptosis, 255
Pubes, dislocation of hip on, 759
Pubic symphysis, disease of, 828
Pulleys in dislocation, 743
Pulpy degeneration of synovial membrane, 815
Pulsatile bone tumors, 876
Puncta lacrymalia, obstruction of, 256
Punctured wounds, 121
Puncture of bladder from rectum, 624
Pupil, artificial, 266
Purulent, ophthalmia, 231
  catarrh of ear, 296
Pus, 25, 29
  absorption of, 30
Pustule, malignant, 137
Puzzle toy, value of, in dislocations, 755

Pyæmia, 53
    analyses of cases of, 56, 59
    post-mortem appearances in, 56
    not hospital disease, 59
    arterial, 314
Pyelitis, 551

QUILLED suture, 120, 675
Quinsy, 384

RABIES, 66
Rachitic affections of bones, 879
Radial artery, ligature of, 349
Radical cure of hernia, 483
    of hydrocele, 646
Radio-ulnar joint, disease of, 830
Radius, dislocations of, 752
    fractures of, 788
    compound, of, 791
Ranula, 88, 372
Rattlesnakes, bites of, 65
Reaction after collapse, 189
Rectal alimentation, 516
Rectangular staff in lithotomy, 598
Recto-vaginal fistula, 676
Rectotomy, linear, 514
Rectum, affections of, 497
    how to examine patient in, 497
    injuries of, 496
    prolapse of, 507
    stricture of, 510
    foreign bodies in, 497
    malformations of, 493
    painful ulcer of, 498
    abscess of, 500
    polypus of, 509
    dilatation of, 515
Rectum, excision of, 515
Recurrent growths, 96
Redness in inflammation, 26
Reduction of dislocations, 743
    of hernia, 469
Refraction, 222
Refracture of bone, 781
Relaxed uvula, 383
Renal calculus, 574
    removal of, 556
    hæmaturia, 553
Repair of wounds, 23, 26
    causes of failure in, 25
    of fractures, 778
Reporting cases, headings for, 21
Resection of joints, 837
    of false joints, 781
Resolution of inflammation, 29
Respiration, artificial, 548
Rest in treatment of aneurism, 320
    in ununited fracture, 780
Retained testis, 667
Retention of urine, 620
    hysterical, 564
Retina, hyperæmia of, 246
    atrophy of, 248
    embolism of, 248
    displacement of, 249
Retinitis, 246
Retraction of nipple, 693
Rheumatic arthritis, 853
Rheumatism, gonorrhœal, 636
Rhinoplasty, 526
Rhinoscopy, 520
Ribs, fracture of, 541
    dislocation of, 543
Richardson's spray producer, 902
Rickets, 879
    operative treatment in, 880
Rider's bone, 720
Rifle-ball wounds, 884
Rodent ulcers, 102
Rudimentary fingers, and toes, 727
Roussel's method of transfusion, 310
Roux's amputation, 927
Rupia, syphilitic, 72
Rupture, abdominal 458
    of abdominal viscera, 435
    of aneurism, 299
    of artery, 299
    of bladder, 433
    of eyeball, 281
    of urethra, 619

SAC, hernial, 460
    omental, 461
    kelotomy external to, 471-2
Sacculated bladder, 559
Sacral tumors, 195
Sacro-coccygeal joint, disease of, 828
Sacro-iliac joint disease, 828
Salivary calculus, 373, 419
    fistula, 374
Salter's swing, 810
Sayre's jacket, 211
Sarcoma, 110
Scab, union under, 25
Scalds, 123
    of the glottis, 533
Scalp, affections of, 180
    contusion of, 154
    wounds of, 155
    sebaceous cysts of, 89
Scapula, dislocation of, 746
    fracture of, 783
    of neck of, 783
Sciatic notch, dislocation of hip into, 757
    hernia through, 490
Scirrhus, 98
Scissors for skin grafting, 130
Sclerosis of bone, 858
Sclerotic, inflamed, 237
    injuries of, 237
Scoop extraction, 272
Scorbutic ulcers, 39
Scrofula, 20
Scrotal tumors, diagnosis of, 663
Scrotum, affections of, 668
    cancer of, 669
    injuries of, 668
    tumors of, 668
    elephas of, 669
Scurvy, 39
Sebaceous cysts, 89
    on head, 89, 180
    fungating, 90
Second intention, healing by, 25
Semilunar cartilages of knee, subluxation of, 763

Spica bandage, 475
Spina bifida, 193
    tumors simulating, 195
Spinal abscess, 209, 212
    instruments, 208
Spinal, wounds of, cord, 205
Spine, concussion of, 196
    diseases of, 208
    fracture and dislocation of, 201
    curvature of, 206
    railway injuries of, 198
Spleen, rupture of, 430
Splints, 774
    immovable, 771
    double thigh, 799, 832
    for excision of elbow, 848
    for excision of knee, 845
Spontaneous cure of aneurism, 318
Sprains of back, 205
    of joints, 739
Spray producer, 902
Squint, operations for, 260
Staff lithotomy, 591
Staphyloma, 237
    removal of, 263
Staphyloraphy, 380
Starched bandage, 776
Statistics of amputations, 905
    of subclavian aneurism, 346
    of torsion, 307
    of necrosis of jaw, 387
    of causes of intestinal obstruction, 443
    of anal abscess, 500
    of exostosis, 871
    of burns, 124
    of cut throat, 528
    of artificial anus after hernia, 468
    after colotomy, 454
    of fractured skull, 160
    of fatal cases of pyæmia, 56
    of pyæmia, 59
    of spinal injuries, 202
    of stricture, 603, 606
    of tetanus, 184
    of abdominal injuries, 429
    of intestinal obstruction, 443
    of hernia, 460, 485
    of stricture of rectum, 512
    of stone, 578
    of lithotomy, 590
    of retention of urine, 620
    of hydrocele, 643
    of cancer of testicles, 662
    of ovarian disease, 696
    of cancer of breast, 689
    of adenoma, 685
    of fracture, 773, 795
    of dislocation of humerus, 746
    of head of femur, 757
    of excision of head of femur, 839
    of excision of knee, 843
    of wounded from gunshot injuries, 881
    of amputation, 905
    of disease of knee, 826
    of hip disease, 821
    of excision of hip, 839
    of excision of knee, 843
    of amputation at knee, 921
    of Syme's amputation, 926
Steatoma, 89
Sterility, 670
Sterno-clavicular joint, diseases of, 829
    dislocation of, 744
Sterno mastoid muscle, contraction of, 739
    induration of, 716
    division of, 739
Sternum, dislocation and fracture of, 543
Stings, insect, 65
Stomach, foreign bodies in, 438
    rupture of, 431
    opening, the, 441
Stomatitis, 372
Stone in bladder, 579
    in kidney, 555
    in urethra, 579, 626
    in woman, 600
Stopping teeth, 413
Strabismus, 259
    operation for, 260
Strangulated hernia, 466
    omental, 467
Strangulation, internal, 443
Stricture, of urethra, 603
    results of, 605
    inflammatory, 624
    spasmodic, 620
    its complications, 614
    traumatic or cicatricial, 617
    treatment of, 607
    causes of death in, 618
    of intestine after hernia, 469
    of œsophagus, 423
    of rectum, 510, 512
Stricture and retention, 623
Stromeyer's cushion, 792
Stumps, affections of, 928
    dressing of, 910
    conical, 929
    bursæ over stumps, 930
    necrosis of, 929
    painful, 929
Styes, 228
Styptics, 307
Subastragaloid amputation, 926
    dislocation, 766
Subclavian aneurism, 345
    artery, ligature of, 346
Subclavicular dislocation of shoulder, 788
Subcoracoid dislocation of shoulder, 747
Subcutaneous ligature of nævus, 336
Subcutaneous operations, 731
    wounds, 122
Subdiaphragmatic abscess, 431
Subglenoid dislocation of shoulder, 747
Sublingual cysts, 372
Submammary abscess, 682
Subpectoral abscess, 545
Subspinous dislocation of shoulder, 748
Suction, removal of cataract by, 272
Sulphuric acid, treatment of disease of bone by, 869
Suppression of urine, 554
Suppuration, 24, 29
Supracondyloid amputation of thigh, 921
Surgical cases, how to investigate, 21
Suspensory bandage, 652
    Morgan's, 668
Sutures, continuous, 119
    interrupted, 119
    quilled, 120
    twisted, 119
    of intestine, 119
Swelling in inflammation, 26, 28
Symblepharon, 254
Syme's amputation of foot, 926
    operation for aneurism, 329
    operation for stricture, 610
Sympathetic ophthalmia, 243
Symphysis pubis, diseases of, 828
Syncope, 309
Synostosis of hip, 825
Synovial cysts, 725
Synovial membrane, diseases of, 815
Syphilis, 71
    sore throat in, 73
    affections of tongue in, 73
    affections of bone in, 74
    pathology of, 74, 654
    treatment of, 75
    hereditary, 77
    teeth in, 79
    serpiginous ulceration in, 80
    marriage after, 80
    inoculation in, 80
Syphilitic disease of rectum, 73, 511
    of iris, 240
    of testicle, 655
    of larynx, 76
Syphilitic teeth, 404
Syphilization, 80
Syringing ear, 287

TAGLIACOTIAN operations, 526
Talipes, different forms of, 730
    their treatment, 732
Tapping abdomen, 455
    ovarian cyst, 698, 706
    hydrocele, 644
    intestines, 455
    chest, 545
    hydatid, 456
Tarsal cartilage, tumors of, 252
Tarsal cysts, 252
Tarsus, operations on, 849
    diseases of, 828
    dislocations of, 766
Taxis, the, 469
    where inadmissible, 470
Teale's amputation, 913
    probe gorget, 611
Tear passages, operations on, 257
Teeth, cysts containing, 390, 403
    syphilitic, 404
Teeth, diseases of, 408
    affections of pulp, 416
    of alveolo-dental membrane, 417
    local dental periostitis, 418
    fracture of, 416
    supernumerary, 404
    supplemental, 404
    malformed, 404
    irregularity of, 406
    impaction of, 407

- Teeth—
  - absence of, 408
  - extraction of, 420
- Temperature in inflammation, 27
  - in traumatic fever, 54
  - in spinal injury, 203
- Temporal artery, ligature of, 345
- Temporo-maxillary articulation, diseases of, 395
  - dislocation of, 396
- Tendo Achillis, division of, 733
  - rupture of, 718
- Tendons, inflammation of, 721
  - rupture of, 716
  - tumors of, 719
  - repair of, after division, 731
  - dislocation of, 716
- Tenotomy, 733
  - in contracted joints, 737
  - in fracture, 811
- Testicle, its development, 650
  - malposition of, 666
  - diseases of, 650
  - inflammation of, 650
  - acute, 653
  - chronic, 654
  - syphilitic, 655
  - gouty, 655
  - tubercular disease, 657
  - hernia of, 659
  - cystic disease of, 660
  - cancer of, 662
  - excision of, 666
  - strapping, 666
- Tetanus, 183
  - infantile, 183
  - pathology of, 185
  - statistics of, 184
- Thecal abscess, 721
- Thermograph of erysipelas, 48
  - traumatic fever, 54
  - enterotomy, 461
- Thigh, amputation of, 920
  - statistics of, 921
  - fracture of, 795
  - compound, 805
- Thomas's splints for knee, 931
  - for hip, 931
- Thorax, injuries of, 543
  - tapping, 545
  - abscesses about, 545
- Throat, wounds of, 528
- Thrombosis, 357
- Thumb, dislocations of, 754
  - compound fracture of, 793
  - amputation of, 919
  - excision of joints of, 849
- Thyroid, cysts of, 88
  - diseases of, 149
  - extirpation of, 153
- Thyroid foramen, dislocation into, 758
- Tibia, dislocation of, 764
  - fracture of, 807
  - V-shaped fracture of, 809
  - arrest of growth after, 808
- Tibial artery, anterior, ligature of, 355
- Tibial artery, posterior, ligature of, 354
- Tic douloureux, 214
- Tinea tarsi, 228
- Toe-nail, ingrown, 141
  - horny, 143
- Toes, amputation of, 928
- Tongue, diseases of, 375
  - hypertrophy of, 375
  - inflammation of, 376
  - extirpation of, 377
  - wounds of, 375
  - ulcers of, 376
  - cancers of, 377
- Tongue tie, 375
- Tonsil, diseases of, 384
  - cancer of, 385
  - excision of, 385
- Tooth, development of, 400
- Toothache, 409
- Tooth cysts, 389, 403, 408
- Tooth tumors, 386, 401
- Torsion on arteries, effects of, 302
  - mode of doing it, 306
  - statistics of, 307, 906
- Torticollis, 739
- Tourniquet, 304
- Towne's stereoscopic test for retina, 227
- Trachea, foreign bodies in, 530
  - wounds of, 528
  - subcutaneous division of, 528
- Tracheotomy, 537
  - its complications, 539
  - for disease of larynx, 534
  - for foreign bodies, 532
  - tubes, 538
  - in tetanus, 186
- Transfusion, 309
- Transplantation of skin, 129
- Traumatic, aneurism, 331
  - delirium, 187
  - fever, 53
  - gangrene, 41
  - stricture, 617
- Trendelenburg's tracheal tampon, 383
- Trephining, skull, 178, 183
  - spine, 204
  - long bones, 862
- Trichiasis, 253
- Trichiniasis, 719
- Trismus, infantum, 183
- Trochanter, fracture of epiphysis of, 800
- Trusses, 490
  - to measure for, 492
- Tubercle, 19
  - mucous, 73
- Tumors, 82
  - sebaceous, of scalp, 90
  - follicular, 90
  - perforating, of skull, 181
  - congenital, of sacrum, 195
  - painful subcutaneous, 215
  - of jaws, 389
  - cystic, 87
  - fatty, 91
  - fibrocellular and myxomatous, 92
  - fibrous, 93
  - cartilaginous, 93, 871
  - osseous, 94
  - myeloid, 94
  - glandular or adenoid, 95
  - vascular, 96
  - papillary, 96
  - recurrent, 96
  - cancerous, 97
  - diagnosis of, 97

Uterus, extirpation of, 712
Uvula, elongation of, 383

V-SHAPED fracture of tibia, 809
Vaccino-syphilis, 81
Vagina, foreign bodies in, 672
  malformations of, 674
  injuries of, 672
Vaginal fistulæ, operations for, 676
Vaginal, cystocele, &c., 676
  lithotomy, 601
Valgus, 737
Valsalva's treatment of aneurism, 321
Varicocele, 667
Varicose, aneurism, 882
  ulcer, 38
  veins, 361
Varix, 361
  aneurismal, 332
Vascular keratitis, 234
Vascular protrusion of eyeball, 150, 277
Vascular tumor, 385
Vault of skull, fracture of, 157
Veins, injection into, 66
  injuries and diseases of, 356
  operations on, 868
  hemorrhage from, 808
  entrance of air into, 851
  varicose, 861
Velum palati, wounds of, 883
Venesection, operation of, 864
  in chest injuries, 543
  in head injuries, 172–6
Venereal diseases, local, 633
Ventral hernia, 490
Verruca, 138
  necrogenica, 64
Vertical extension in fracture, 803
Vesico-intestinal fistula, 439, 561
Vesico-prostatic calculus, 569
Vesico-vaginal fistula, 676
Vienna paste, 105
Villous growths, 103
  of bladder, 562
  of rectum, 509
Viscera, abdominal, protrusion of, 435
  rupture of, 428
  wounds of, 437
Vision, field of, 226
  anomalies of, 246
Vitreous humour, affections of, 243
Volvulus, 444
Vulva, injuries of, 672
Vulvitis, 678

WARDROP'S operation for aneurism, 327
Warts, 138
  anal, 510
Warts—
  venereal, 139, 629
Wax in ear, 283
Weak sores, 86
Webbed fingers and toes, 728
Weight, extension by, 798
Wens, 180
Wheelhouse's operation for stricture, 609
Wind contusions, 884
Windpipe, foreign bodies in, 530
Women, surgical diseases of genitals in, 177
  stone in, 600
Wounds, 118
  dressing of, 120
  arrow, 122
  subcutaneous, 122
  poisoned, 63
  antiseptic treatment of, 911
Wrist, amputation at, 918
  dislocation at, 754
  suppuration and excision of, 849
  diseases of, 830
Wryneck, 739

XANTHELASMA of lids, 253
Xanthic oxide calculus, 577

ZINC, chloride of, paste, 105

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